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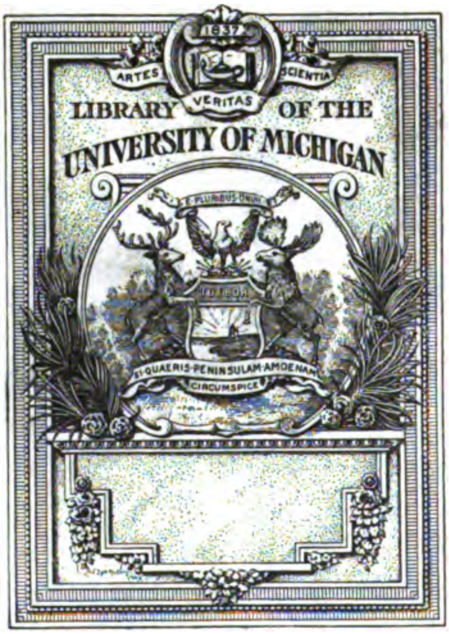
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THE ART OF COMPOUNDING

SCOVILLE

THE

ART OF COMPOUNDING

A TEXT BOOK FOR STUDENTS
AND
A REFERENCE BOOK FOR PHARMACISTS
AT THE PRESCRIPTION COUNTER

BY
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THIRD EDITION, REVISED AND ENLARGED

PHILADELPHIA
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PREFACE TO THIRD EDITION.

WHILE the immediate reason for a revision of this work was to bring the book into accord with the ninth decennial revision of the United States Pharmacopœia, yet the principal changes have been made on extra-pharmacopœial matter. Most of the subjects have been enlarged by a selection of matter that is likely to be of use at the prescription-counter.

A chapter on Tablets has been added, which treats of the manufacture of compressed and triturate tablets. The use of tablet machines is increasing in connection with prescriptions, and the simplifying of the principles governing tablet-making will be welcomed by many dispensers.

Occasional demands for a sterilized preparation, or for the sterilization of implements or articles for surgical or medicinal use, is the warrant for the added chapter on Sterilization and Disinfection. No attempt has been made to cover the whole field in this subject, but only to treat it so that any demands which the pharmacist may meet can be intelligently fulfilled. For valued advice in this chapter I am indebted to Dr. H. J. Perry, Instructor in Bacteriology at the Harvard Medical School, and also at the Massachusetts College of Pharmacy, who kindly made final corrections in the manuscript.

The subject of Emulsions has been largely rewritten, and includes the latest theories of emulsification and also improved methods and formulæ for commercial emulsions.

Capsules are more fully treated in the chapter on Powders, and many additions have been made to the chapter on Incompatibilities.

The author would welcome any suggestions or criticisms on any of the subjects treated, from any source.

WILBUR L. SCOVILLE.

BOSTON, MASS., September, 1904.

193999

PREFACE TO THE SECOND EDITION.

The favor with which the first edition of this work was received, both as a text and a reference book, has justified a careful revision.

As a text-book it was in the nature of an innovation, and its value as such was questioned, but its adoption by several schools during the two years has apparently demonstrated its usefulness in this regard.

In the present edition some new matter is introduced, both in the text and in the prescriptions. A number of additions have been made to the chapter on Incompatibilities, and a useful table has been added to the chapter on Ointments. A few minor errors which were overlooked in the first edition have been corrected.

In the present edition a free use is made of heavy display type for the double purpose of emphasis and convenience of reference. Attention is, however, called to the fact that a considerable information is contained in the prescriptions, in which form it does not admit this style of emphasis.

Special pains have been taken to index the prescriptions, and the author recommends that a free use of the index be made when referring to any topic. Many points are thus treated which are not touched upon in the general text. Students will also find it helpful to study the prescriptions for the same reason, and for the direct applications made.

The prescriptions have been carefully selected to illustrate the principles contained in the text, and many formulas for domestic or common preparations are included in order to give as wide and varied a range as possible. These latter are typical of many preparations which the pharmacist is, at times, called upon to prepare.

The author would be very glad to receive from readers, copies of any interesting or difficult prescriptions or formulas, and will gladly assist, in so far as he may be able, in the compounding of any not already included in this work.

WILBUR L. SCOVILLE.

BOSTON, October, 1897.

PREFACE TO FIRST EDITION.

THE art of compounding physicians' prescriptions depends largely upon an intellectual grasp and a practical application of small details. Very slight differences in operations upon the same prescription are frequently sufficient to make all the difference between a presentable and an unpresentable mixture.

In attempting to teach this subject from the standpoint of the prescription counter, the author has been obliged to depend almost entirely upon lectures for the presentation of the different topics, the literature upon the subject being too widely scattered to admit of use by the students.

This necessitated the omission, in order to avoid confusion, of many of the details connected with each which make them of practical value, and much was lost to the student thereby.

The present work was begun with a view to furnishing such notes as would enable students to properly classify the various prescriptions, and to attach proper importance to details of manipulation without overburdening the mind with disconnected facts. As the theme unfolded it was thought that the same elements which would make it of aid to students might also make it of value as a reference book, and the work has therefore been made more complete than was first planned. That very much is still lacking the author is fully aware.

In presenting the subjects, two objects have been kept in view. First, to enunciate and classify the principles underlying each subject, so that the student may understand the reasons as well as the facts of dispensing; second, to so illustrate and detail the principles as to show their range and variety of application, and make them of practical utility at the prescription counter. The first is undertaken in the general text, the subjects being broadly introduced by a series of definitions, wherever admissible, then the descriptive and theoretical considerations are given. The prescriptions which follow the chapters were selected and arranged with the second object in mind. While intended primarily for practice in compounding, they should teach not only the methods of mixing, but also the direct application of the principles, the physical properties of the materials used, and, in some degree, the range and variety of extemporaneous pharmacy. The official formulas which have been included, are designed as well to give practice in the compounding of an aliquot part of a common formula — an exercise frequently demanded in commercial life. Peculiar prescriptions which seemingly form exceptions to the general rules, or are of rare application, or such as call for special treatment, are illustrated by example, this plan seeming to be less cumbersome or confusing than if the many disconnected facts were embodied in the descriptive text. While intended only for extemporaneous pharmacy, the line has not been closely drawn, and in a few cases the quick manufacture of a chemical salt is demanded, as showing the extent to which the exigencies of compounding may lead.

While illustrative cuts would undoubtedly have been an attractive addition to the text, it has been preferred to omit them, in the belief that such demonstrations in the use of apparatus which the apprentice receives in the store, or the student witnesses at college, are more suited to their needs, while the maturer pharmacists are best supplied by catalogues and technical journals.

Pharmaceutical literature has been freely used in collating the facts herein presented, many of them being collected from the "Proceedings of the American Pharmaceutical Association," the "Art of Dispensing," and files of the "Pharmaceutical Journal and Transactions," "American Druggist," "Bulletin of Pharmacy," "American Journal of Pharmacy," and other journals. In the chapter on Incompatibilities, special recognition is due to assistance received from a series of articles on that subject by Mr. Frank X. Moerk, published in the "Bulletin of Pharmacy," during 1895. Grateful acknowledgments are also made to Professor E. L. Patch for permission to use certain prescriptions from his "Junior Laboratory Exercise Book."

WILBUR L. SCOVILLE.

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THE ART OF COMPOUNDING.

CHAPTER I.

INTRODUCTORY.

One of the chief objects of a technical education is the acquirement of skill.

And skill involves two things: first, mental knowledge and the power to rightly apply it, and second, manual dexterity.

The first comes to us by reading and study, and in the various ways by which the mind receives the thoughts of others in words.

The second involves a knowledge which cannot be put into words, but must come to us through the medium of the five senses. Each of the senses is a channel through which thoughts are conveyed to the mind, and its mission can be fulfilled by no other means. The skillful man is the wholly trained man; one who has not only learned how to apply the knowledge of others and to judge and plan for himself, but who knows also how to execute, and make inanimate things do his bidding.

This double training is essential for the acquirement of skill in all lines of work. In pharmacy, study and reading will give one a correct idea of how to make a pill, or to divide powders, mould suppositories, etc., but manual practice is necessary to enable one to accomplish these operations neatly and expeditiously.

Or mechanical dexterity may be acquired so that these operations, when applied to familiar examples, are easy; but unless the principles involved are understood, new combinations are puzzling, and the mechanical dexterity alone is inadequate to their correct preparation.

By study the knowledge and experience of others are made available to us, and we learn to deduce new methods or to newly apply principles. Study has for its object the assimilation of the thoughts of others. To this end the thought involved in the sentences must first be understood.

Take for instance this sentence: "After a toxic dose the systolic irritation overbalances the diastolic stimulation, and the pulse becomes dicrotic, because the diastole is interrupted by an abortive systole" (U. S. Disp., page 478). What idea do these words convey to you? If the meaning of each word is clear, then the sentence as a whole is readily understood; but if any word is not understood, the significance of the entire sentence is obscured. A dictionary may clear up the meaning, or a course in the physiology of the heart may be necessary for its full understanding.

The student should make it a rule never to leave a sentence until the meaning of every word and of the sentence as a whole is perfectly clear. Then a few repetitions in reading it serve to fix the thought in the memory. But the key to proper study lies in the first careful reading of the lesson, and the comprehension of the significance of every word.

Then for prescription work and the operations of pharmacy there is something beyond this. Study may enable us to see quickly what principles to apply to any mixture, but the physical properties of the compound are still to be known. These, if thoroughly learned, will teach us not only the art of mixing, but also safeguards against mistakes or inferiority in the stock. Drugs should be to the pharmacist like intimate friends, their appearance, habits, likes, and dislikes, all familiar. These are learned by close observation, — through the medium of the senses. Let us see how these apply.

Seeing. — This sense is so very important in pharmacy that a special branch is devoted to it, —that of Pharmacognosy.

But its application to the compounding of prescriptions is none the less instructive, though so varied that it can hardly be classified into a course. The habit of close observation is not an easy one to acquire, but it is exceedingly useful.

Take the ingredients of any mixture, and look at them separately. Are they clear or cloudy ? Is there a deposit upon the side or bottom of the bottle ? What are the colors and how do they change ? Are they limpid or viscid ? Do they appear the same by reflected as by transmitted light ? Such questions can only be answered accurately after careful and repeated observations.

Then on mixing observe again.

Do the liquids mix clearly or not ? Are streaks or currents formed in the liquid, and what do they denote ? Do solids dissolve quickly or slowly ? Do they diffuse readily ? What changes in color occur ? Is there *any* effervescence or precipitation ? etc.

Such observations make an excellent course in physics, and the pharmacist who practices them habitually will never send out a gritty or streaked ointment or suppository, nor an ill-appearing mess of any sort.

It is not necessary that one should be able to describe all that he sees, for these are the thoughts conveyed without words, and, moreover, "it is quite sufficient" (says Professor Markoe), "to recognize your friends when you see them, though you may not be able to make a list or give a description of all of them."

Hearing. — This sense is the least applicable (directly) of any, to pharmacy.

The popping of a cork should suggest a cause to the pharmacist, and it may indicate the need of attention to the bottle.

An acute ear behind the prescription counter may prevent pilfering by kleptomaniac customers, while the sound of running water may bring suspicion to the customer's mind of a cheap ingredient of his prescription.

A crash may denote trouble and loss.

But in general, silence is more indicative of a good dispensing counter than noise, and there are times when a closed ear is better than an open one.

Smelling. — This is a sense which can receive little aid from outside. An odor is absolutely indescribable, except by analogy, and is comprehended only by the nose. The only way to analyze a perfume is by means of an educated nose, and that needs a deal of educating. Most fluids, and many solids, have a characteristic odor by which they can be identified. It should be remembered, however, that a diluted odor is more characteristic than a concentrated one. The most delicate and pleasing perfumes have a more or less harsh and disagreeable odor when concentrated, but on diluting them the pleasing and distinguishing odor is manifested.

Unless a liquid has, normally, only a weak odor, smelling from the bottle is not a good plan. A drop or two allowed to fall upon a piece of filter paper, which is then waved in the air for a moment, will enable us to get the true odor, and also its relative strength.

Another peculiarity of odors is their anæsthetic action upon the olfactory nerve, particularly true of flowers and delicate odors. After a very few minutes the nerve is benumbed, and the odor is no longer perceptible, or ceases to be pleasant. Nor can other odors be distinguished clearly, since "all smell alike," as the over-zealous samplers at the perfume counter sometimes say. For this reason but two or three odors can be learned at a time.

Besides the more characteristic properties developed by dilution of odors, the smelling of strong and pungent bodies like ammonia water, chlorine solutions, essential oil of mustard, strong nitric or hydrochloric acids, etc., from the bottles, is liable to result in unpleasant or even serious results.

Tasting is closely related to smelling, the odor often suggesting the taste.

Like the odors also, taste is oftentimes more characteristic in the diluted than in the concentrated form. A grain of quinine sulphate, for instance, placed upon the tongue, quickly betrays its bitterness, but the same amount dissolved in two and a half pints of water shows also, on being tasted, how intensely bitter the quinine is, without being so persistent and unpleasant.

A grain of strychnine, dissolved in twenty gallons of water, can be tasted distinctly in the solution, and in this diluted condition the distinction between the quinine and the strychnine bitter is more pronounced. Saccharin has a nauseous, metallic taste when placed upon the tongue, but in dilute solution it is intensely sweet and is agreeable. The characteristic taste of the most powerful poisons can be safely ascertained *in highly diluted solutions*, but the solid forms or strong solutions are dangerous, particularly hydrocyanic acid and the cyanides. The degree of dilution must, of course, vary with the diffusibility of the taste and the dose of the substance.

Sometimes the presence of one substance develops or obscures the taste of another.

Thus, a very small proportion of salt or of vinegar makes sugar taste sweeter, while licorice or coffee partially covers the taste of bitter substances.

Efforts are constantly being made to find means of covering the taste of unpleasant substances, and our list of elixirs is one result of such.

The sense of taste also furnishes a means of identifying many substances. We quickly learn that a sour taste indicates an acid or an acidulous salt; a sweet taste may mean sugar or saccharin or glycerin; a bitter taste comes mostly from tonic or cathartic drugs; and an astringent taste may be due to tannic acid or to a salt of aluminum, lead, zinc or copper. Some pharmacists make a habit of tasting mixtures compounded for internal use, to verify their correctness or detect mistakes. This is not so unpleasant a habit, properly applied, as might seem.

A few drugs, when applied to the mouth and fauces, produce sensations more akin to the touch than to the taste. Tincture of aconite, highly diluted (one drop to twenty or thirty fluidounces of water), produces a tingling sensation and numbness when a teaspoonful of the liquid is held for a full minute under the tip of the tongue. The tingling is not apparent for a few moments, but continues for some time. Cocaine produces a numbness quickly, and chloroform first burns, then benumbs.

A tingling or a numbing sensation is produced by a number of drugs. A few drugs, as soap bark and hellebore (and, in unusual cases, aloes and its preparations), cause sneezing, while very rarely an extremely sensitive individual will suffer severely if ipecac be exposed even for a moment within a distance of several yards.

All such sensations are characteristic of their respective causes, and are valuable as a means of testing or as hints of the general properties of the drugs. The quality of a drug or preparation is oftentimes quickly and accurately ascertained from its taste.

Feeling.—"Knack"—that indescribable something which lightens labor and passes for skill—is mostly an educated sense of touch. There is a peculiar "feel" to a workable pill or suppository mass, an emulsion, powder-mixture, troche, tablet, etc., indeed to all mechanical operations, which tells us what words or pictures or sounds cannot. It must come to us through the nerves, in our operative practice, and once learned it is rarely forgotten. It is this which enables us to weigh, to mix, to mass, to divide, to roll into shape, quickly and well.

The "knack" of holding large bottles in pouring, of handling graduates, mortars, spatulas, and all the various implements, gracefully and rightly, is acquired through the sense of touch.

We also find that the feeling of many powdered or crystalline substances is characteristic, and a rough test can be made of the quality or purity of many articles in this way. Such tests have served for the detection of gross sophistications, and are of considerable value in comparing samples of chalk, zinc oxide, etc. Some pharmacists always test ointments containing insoluble powders for grittiness, by feeling them before removing from the slab or mortar. Mixed powders are also tested in the same manner, when one ingredient is harder than the others.

These are the purposes of the prescriptions which follow each chapter in the succeeding pages. They are intended for practice as well as for study. Nor is the manner of mixing the only, or even, from the educational standpoint, the chief thing to be learned The physical properties of the ingredients and mixtures should be studied, and deductions made from them. It may be discovered that many of them can be mixed in various ways, and further that "there is no dispensing rule but must be applied subject to the control of the judgment and experience of the operator."

CHAPTER II.

THE PRESCRIPTION.

The prescription is the written order of a physician for a remedy, usually accompanied with directions for its administration to the patient. Its design is to procure for the patient a special remedy, suited to his present condition, and in such quantity as the physician deems needful.

The word prescription is derived from the Latin word *præscribo*, I write before (*præ*, before, and *scribo*, I write or ordain).

THE LANGUAGE of the prescription is almost universally Latin, because (1) Latin is the language of science throughout the world. Thus a prescription written in any part of the civilized world, or by a physician of any nationality, may be readily comprehended and correctly compounded by any pharmacist.

(2) The Latin names of medicines are definite and not subject to the changes common in modern languages. Thus, the Latin term *Gaultheria* means a definite plant, understood by botanists and pharmacists everywhere, but the English equivalent, "Wintergreen," might be interpreted Gaultheria or Chimaphila. Likewise *Serpentaria* means only a particular and known root, but the English term "Snake-root" may be applied to *Serpentaria*, *Cimicifuga*, *Senega*, *Asarum*, or *Eryngium*. Moreover, the vernacular name of a plant is one thing in English, another in French, and still another in German, Italian, Spanish, etc. The use of Latin obviates the necessity of knowing these different names as well as procures accuracy.

(3) Oftentimes it is desirable that the nature and ingredients of a mixture remain unknown to the patient, and Latin affords secrecy. This last reason should be remembered and respected by the pharmacist, and inquiries regarding the composition and nature of a prescription should be answered with caution. It may be unobjectionable to answer frankly such questions when asked by people of high intelligence and with honorable motives but in most cases an evasive reply, which conveys little or no information, is advisable. Prescriptions often betray secrets which should be zealously guarded, and, in France, it is a criminal offense to expose their contents or nature to outside inquirers.

The prescription is usually written in three parts: (1) the inscription or ingredients; (2) the directions to the compounder; and (3) the signature, or directions for the patient.

The physician's name, or initials, also forms an integral part of the prescription. This is often printed upon the blanks used.

The inscription and directions to the compounder are written in Latin, the signature either in Latin or English ; usually in English, since there is no advantage in writing it in Latin, and there may be a disadvantage through an improper interpretation.

The prescription opens with the symbol ℞.

This was probably in the original, the sign of Jupiter, ♃, placed at the head as a prayer for favor and healing to that deity — such a custom being common in the days of mythology and superstition. It is now generally understood as standing for the imperative form of the Latin verb *recipio*, " I take," *recipe*, " take thou."

The ingredients of the prescription then follow, and are grammatically dependent upon this verb *recipe*.

The quantity of each ingredient is a direct object of the verb, and is designated by the accusative case, while the ingredients modify the quantities, and are in the genitive. These are followed by the sign ♏ or M, standing for the verb *misce*, " mix," and any directions to the compounder that may be necessary, as —

" *In chartulas xii numero divide*," divide into twelve small papers (powders) ; " fiant in pilulas xx numero," let them be made into 20 pills ; " fac suppositoria vi numero," make (thou) 6 suppositories ; " fiat unguentum," let an ointment be made, etc.

Take a single prescription for illustration :

℞. Morphinæ Sulphatis,..................grana dua.
Sacchari,......................drachmam unam.
Misce et divide in chartulas duodecim.
Signatura : — Capiat unam nocte.

Here the verb *recipe* (take) has for its direct object *grana* (grains), which is therefore in the accusative case, and *dua* (two) being a numerical adjective agrees with it. *Sulphatis* being in the genitive case (corresponding to the possessive in English) tells us what the substance of the powder is, and *morphinæ*, also in the genitive, modifies *sulphatis*, and the sentence reads literally, " take of the sulphate of morphine, two grains."

In the next line the verb is again understood, but is not written ; it has for its direct object *drachmam* (a drachm, singular) and *unam* (one) agrees with this. Then *sacchari* is in the genitive, and the line reads, " take of sugar one drachm." This forms the inscription or the first part of the prescription.

Then follows the imperative verb *misce*, mix, joined to the succeeding sentence by the conjunction *et* (and). *Divide* (imperative form of verb, meaning " divide ") tells us that the mixture is to be mixed and divided, and the succeeding words how. *In* is a Latin preposition meaning "into" when followed, as, in this case, by the accusative (or "in" when followed by the ablative), and *duodecim* is indeclinable, but agrees with *chartulas*. Then this sentence reads "mix and divide into twelve powders."

The last part of the prescription, the signatura, is in this case also in Latin.

Signatura means "write" or "directions," the directions being,—*capiat*, subjunctive form of the verb *capio*, and means "let the patient take." *Unam* (one) is the direct object of *capiat*, and is, therefore, in the accusative, while *nocte* (at night) is in the ablative because it expresses time. This sentence then reads, "let the patient take one (powder) at night."

In the every-day writing of prescriptions many of the terms and phrases are abbreviated.

Thus ℞ stands for *recipe*, ♏ for *misce*, S. or Sig. for *signatura*, and the quantities are designated by signs and Roman numericals.

Abbreviations are not objectionable if not ambiguous, but some are of the latter nature.

A prescription was received in a western state some time ago as follows:

℞.	Hyd. chlor..........................	ʒi
	Mur. hyd.,..........................	gr. ii
	Aquæ, ...	℥i.—♏.

This should take the prize for ambiguity, for the abbreviations "chlor." and "mur." are synonymous, the second being an old form still in common use, standing for muriate (chloride), muriatic, etc., while "hyd." occurs in both cases. The first line then might stand for "hydrargyri chloridi"—chloride of mercury, and this might be either calomel or corrosive sublimate, or it might stand for hydrate of chloral. The second line, at first thought, would be supposed to mean the same. But the physician really desired in this prescription,

Chloral (hydrate),................	one drachm.
Muriate (hydrochlorate) of hydrastine,	two grains.
Water (distilled),................	one fluidounce.

Further, the abbreviation "hyd." might stand, in different connections, for hydrargyrum, hydrate, hydrochlorate, hydrocyanide, or hydriodate while "chlor." might be intended for chloride, chlorinated, chlorate, chlorine, chloral, or chloroform.

"Sulph." might stand for sulphur, sulphide, sulphite, or sulphate, and "phos." for phosphorus, phosphide, phosphite, or phosphate.

It may be noted that a **knowledge of classical Latin** is not a necessity to the pharmacist, but it is a great aid and a stimulus to a wider education and a better understanding of technicalities. Without it the compounder must depend upon the unaided memory, or upon tables of technical terms.

Classical Latin contains but few of the technical terms, but it makes the student familiar with construction, idioms, etc., so that these are more readily learned, remembered, and understood.

RECEIVING THE PRESCRIPTION.

It is customary in some of the larger stores to give checks upon receiving a prescription. The checks are numbered or lettered, and the corresponding mark or a duplicate check is written upon or attached to the prescription. This prevents mistakes in delivering the medicines, the check or mark being transferred to the packages as these are prepared.

The prescription should be read carefully and thoroughly. *Make it a rule never to dispense a prescription any part of which is not well understood.*

The character or strength of a mixture often depends upon a single word or sign, and a careful scrutiny is always necessary.

Many pharmacists write the label before beginning to compound the prescription — an excellent practice. This gives time for a second reading or for any hints which may be noted in the directions, and also for thought as to the manner of compounding; moreover, the label then becomes thoroughly dry before being pasted upon the bottle.

The legibility of a prescription is as often as much a matter of experience in the compounder, as of the chirography of the writer.

Dispensers gradually become accustomed to certain combinations, and the presence of one ingredient suggests another, or at least makes the interpretation of a more obscure line easier. They also become familiar with peculiarities in the handwriting of physicians in their locality, and prescriptions which may seem to be mere hieroglyphics to the novice or to dispensers in another town may be simple and plain to them.

So then the ability to decipher a badly written prescription depends quite as much upon experience in dispensing as upon skill in interpreting badly-formed letters.

If any ambiguity occurs in the prescription, any dangerous doses, undesirable incompatibilities, or any other feature, makes it desirable that the physician should be consulted before the prescription is compounded, the customer should never be made to suspect that anything is wrong. The latter may be dismissed with information that the prescription will require an hour or two to compound, or some such excuse, and the prescription sent to the physician without his (the customer's) knowledge. Faith in both the physician and the pharmacist is an important factor in medical treatment, and it should be fostered at all times.

The doses of powerful remedies should be carefully scrutinized in each case.

Many a life has been saved by the watchfulness of pharmacists in this regard, and the reputation of the physician preserved as well.

On the other hand, the pharmacist is held criminally liable with the physician, by the law, if he compounds and dispenses a prescription containing a fatal dose of poison.

Unusual doses of powerful drugs are sometimes purposely ordered by physicians for special cases. This is particularly liable to occur with morphine and opium and their preparations. In such cases the physician alone is responsible, provided the dose was ordered thoughtfully.

Several plans for designating such special doses have been proposed, such as drawing a heavy line, for emphasis, under the dose and remedy in question, the writing of the dose in both Roman and Arabic characters, or in both English and Metric systems, the emphasizing of the dose by an exclamation mark (!) or by the letters Q. R. (quantum rectum), etc., and it is to be regretted that some method has not been universally adopted. Occasions frequently arise when from abnormal conditions, extreme pain, or other causes, doses may be needed which in ordinary usage would be dangerous, and delay in compounding these (which are usually wanted quickly for relief) would be avoided many times by some recognized method.

In judging of the safety of a given dose, three things must be taken into account, (1) the age or weight of the patient, (2) the form in which it is given, and (3) the frequency or extent of its repetition.

Doses are usually given in tables, books on posology, etc., as maximum and (sometimes) minimum doses for adults, but even with adults personalities make much difference. As a rule a man will stand a larger dose than a women, and a heavy muscular man more than a light and nervous one. For children the dose is regulated according to age. Dr. Young's rule, which is frequently used, is, " Divide the age of the child, in years, by the age plus twelve." For example, if the child be three years old, the dose would be $\frac{3}{3+12} = \frac{3}{15}$ or $\frac{1}{5}$, and the dose is therefore one fifth that of an adult. Another rule is to add 1 to the age in years, and divide by 24,—thus for the same child (3 years old) calculate $\frac{3+1}{24} = \frac{4}{24}$ or $\frac{1}{6}$; the dose then is one-sixth that given to an adult.

It must be remembered that infants and young children are extremely sensitive to morphine and opiates, death resulting at times from seemingly very small doses, and judgment must be used as well as rules.

The form in which the medicine is administered also affects its vigor. Hypodermic injections, by bringing the remedy directly and suddenly into the circulation, effect a full action in smaller doses than when the drug is administered in other forms.

Liniments, ointments, suppositories and other external or semi-external remedies, acting by slow and gradual absorption, produce their effects more slowly than when administered by the mouth, and larger doses may, as a rule, be administered in these forms.

Suppositories of strychnine or nux vomica (and ignatia) are an exception here, since strychnine acts very quickly and vigorously when administered through the rectum, and smaller doses are therefore advisable.

Bodies in solution generally act more promptly than when in solid form, and so *insoluble* forms of medicinal agents may sometimes be used in larger amounts.

Very little difference is noted, however, in the dose of remedies in pill or powder forms and solutions.

The frequency or extent of repetition of a dose is decidedly important with some drugs. Some are fugitive in their action, while others are cumulative.

With opium (morphine) and cocaine, for instance, the action is prompt and soon passes away. The system quickly becomes accustomed to them, and an increase in dose becomes necessary to produce the desired effect. Such drugs may be given in repeated doses without ill effects other than the establishment of a systemic craving for them, if long continued.

Cumulative drugs, on the other hand, like strychnine, nux vomica and digitalis, do not produce their full effects at once, but gradually accumulate in the system, their action increasing with the drug.

Small, repeated doses may thus give rise, after a time, to symptoms of poisoning similar, though less dangerous, to those produced by a single excessive dose.

A questionable dose of such remedies as these becomes more apprehensive if the mixture contains a large number of doses which are to be taken at frequent intervals.

here **The difference between a minim and a drop** should also be borne in mind in figuring doses. A minim is always a sixtieth part of a fluidrachm regardless of the character of the substance, while a drop varies from a forty-fifth to a two-hundred-and-fiftieth part, according to the viscidity of the fluid. Aqueous fluids usually measure from 45 to 70 drops to the fluidrachm; alcoholic liquids, 100 to 150 drops; ethereal liquids, 150 to 250 drops; and volatile oils, 110 to 145 drops to the fluidrachm. The size of the drops will vary, in the same liquid, with the shape and character of the vessel from which they are dropped, particularly as regards the edge or lip, with the rate of dropping and, to some extent, with the temperature.

Consequently, tables like the following are not to be taken as absolute, but as approximate guides.

DROPS IN A FLUIDRACHM.

A table showing the number of drops in a fluidrachm, also the weight of one fluidrachm in grains and grams for each of the preparations named, from a list by S. L. Talbot, first printed in Remington's "Practice of Pharmacy," and corrected to agree with the U. S. P., 1890. — *Taken from the Era Dose Book.*

NAME.	DROPS IN FLUIDRACHM. 60 MIN.	WEIGHT OF FLUIDRACHM.	
		In Grains.	In Grams.
Acetum Opii	90	61	3.95
Scillæ	68	57	3.69
Acidum Aceticum	108	58	3.75
Aceticum Dilutum	68	55	3.56
Carbolicum	111	59	3.82
Hydrochloricum	70	65	4.21
Dilutum	60	56	4.62
Hydrocyanicum Dilutum	60	54	3.49
Lacticum	111	66	4.27
Nitricum	102	77	4.98
Dilutum	60	58	3.62
Nitrohydrochloricum	76	66	4.27
Phosphoricum Dilutum	59	57	3.69
Sulphuricum	128	101	6.54
Aromaticum	146	53	3.43
Dilutum	60	58.5	3.79
Sulphurosum	59	55	3.56
Æther	178	39	2.52
Alcohol	146	44	2.85
Dilutum	137	49	3.17
Aqua	60	55	3.56
Ammoniæ Fortior	66	50	3.24
Destillata	60	53.5	3.46
Balsamum Peruvianum	101	60	3.88
Bromum	250	165	10.69
Chloroformum	250	80	5.18
Copaiba	110	51	3.30
Creosotum	122	56.5	3.66
Extractum Belladonnæ Radicis Fluidum	156	57	3.69
Cimicifugæ Fluidum	147	48	3.11
Cinchonæ Fluidum	138	58	3.75
Colchici Radicis Fluidum	160	37	3.69
Seminis Fluidum	158	55	3.56
Digitalis Fluidum	134	49	3.14
Gelsemii Fluidum	149	59	3.14
Hyoscyami Fluidum	160	59	3.82
Ipecacuanhæ Fluidum	120	60	3.88
Pareiræ Fluidum	140	51	3.72
Rhei Fluidum	158	61	3.95
Sarsaparillæ Fluidum Compositum	134	60	3.88
Senegæ Fluidum	137	62	4.01
Serpentariæ Fluidum	148	47	3.07
Uvæ Ursi Fluidum	137	60	3.88
Valerianæ Fluidum	150	49	3.17
Veratri Viridis Fluidum	150	50	3.24
Zingiberis Fluidum	142	48	3.11
Glycerinum	67	68	4.40
Liquor Acidi Arsenosi	57	55	3.56
Ammonii Acetatis	75	56	3.62
Arseni et Hydrargyri Iodidi	58	55	3.56

DROPS IN FLUIDRACHM — CONTINUED.

NAME.	DROPS IN FLUIDRACHM. 60 MIN.	WEIGHT OF FLUIDRACHM.	
		In Grains.	In Grams.
Liquor Ferri Citratis	71	72	4.65
Nitratis	59	59	3.82
Subsulphatis	73	83	5.37
Tersulphatis	83	72	4.66
Hydrargyri Nitratis	131	123	7.97
Iodi Compositus	63	59	3.82
Potassæ	62	58	3.75
Potassii Arsenitis	57	55	3.56
Sodæ Chloratæ	63	62	4.01
Zinci Chloridi	89	88	5 70
Oleoresina Aspidii	130	52	3.36
Capsici	120	51	3.30
Cubebæ	123	52	3.36
Oleum Æthereum	125	50	3.24
Amygdalæ Amaræ	115	55	3 56
Expressum	108	48.5	3.14
Anisi	119	54	3.49
Bergamottæ	130	46	2.98
Cari	132	50	3.24
Caryophylli	130	57	3.69
Cinnamomi	126	53.5	3.46
Copaibæ	123	49.5	3.20
Cubebæ	125	51	3.30
Fœniculi	125	53	3.43
Gaultheriæ	125	62	4.01
Juniperi	148	49	3.17
Lavendulæ Florum	138	52	3 36
Limonis	129	47	3.04
Menthæ Piperitæ	129	50	3.24
Ricini	77	51.5	3.33
Rosæ	132	47	3.04
Rosmarini	143	50	3.24
Sassafras	133	58	3.75
Terebinthinæ	136	45.5	2.94
Tiglii	104	50	3.24
Spiritus Ætheris Compositus	148	45	2.91
Ætheris Nitrosi	146	47	3.04
Ammoniæ Aromaticus	142	48	3.11
Chloroformi	150	48	3.11
Menthæ Piperitæ	142	47	3.04
Syrupus	65	72	4.66
Ferri Iodidi	65	77	4.98
Tinctura Aconiti	146	46	2.98
Belladonnæ Foliorum	137	53	3.43
Cantharidis	131	51	3.33
Cinchonæ Composita	140	49	3.17
Digitalis	128	53	3.43
Ferri Chloridi	150	53	3.43
Iodi	148	47	3.04
Nucis Vomicæ	140	44	2.85
Opii	130	53	3.43
Camphorata	130	52	3.36
Deodorata	110	54	3.49
Valerianæ	130	52	3.36
Veratri Viridis	145	46	2.98
Zingiberis	144	46	2.98
Vinum Colchici Radicis	107	55	3.56
Seminis	111	54	3.49
Opii	100	55	3.56

In considering **the manner of compounding,** the first thought should be the aim of the prescriber. To interpret this intelligently a general idea of the uses of medicine should be had, so that minor changes may be suggested if improvements can be secured thereby. Criticisms or suggestions as to the therapeutic action of remedies should never be indulged in, but hints toward better pharmaceutical preparations are often welcomed.

Incompatibilities should receive full attention, and be avoided whenever possible.

Always aim at a clear mixture, or, where this is impossible, at a mixture in which any insoluble substance can be evenly diffused by gentle shaking.

Besides this, the proper use of tools should receive attention. Graduates, mortars, spatulas, etc., should be used freely, but not needlessly.

"A good dispenser," says Mr. Ince, "leaves few traces of his work behind him."

The avoidance of incompatibilities and the proper measuring or mixing of powerful remedies, is always first, but beyond this the following of a resinous or sticky tincture in the graduate by an alcoholic liquid or of a syrup or mucilage by water, or any successive order which tends to leave the utensils in a less sticky or dirty condition, is as much an evidence of skill and thoughtfulness as the appearance of the mixture itself.

Containers should be chosen to fit as closely as possible the finished mixture.

Liniments should be dispensed in poison bottles, but powerful and poisonous preparations, which are usually dispensed in these, when sold without prescription, are preferably dispensed in the common white bottles when ordered on prescriptions, the dose being plainly marked on the label. If the word "poison" is to appear also upon the label, a poison bottle may be used, but frequently the physician does not wish that the dangerous properties of the remedy shall be known to the patient.

Powders are best dispensed in boxes or bottles, whether divided or not. Those which change easily in the air, as the granular effervescing powders, should always be dispensed in wide-mouthed bottles.

In fitting stoppers to bottles, choose a cork which is a little too large rather than one which is small. The latter is apt to get crowded so far into the neck that a hold cannot be secured upon it with the fingers, and a cork-screw or some implement is necessary for its withdrawal; or it may even be crowded into the bottle. Either condition is inconvenient and very annoying in a sick room; moreover it is needless. A cork which is a trifle large is easily reduced by means of the cork-press, and is more agreeable to the patient or nurse. Cork-presses are made for use, not for ornament.

✓ **Checking.** — After the compounding and labeling of the prescription, a system of checking is followed in the best pharmacies.

Another clerk takes the written prescription and reads it aloud, the compounder following the reading and mentally reviewing the process of compounding. Or the compounder may state what he has compounded, from memory, while the checking clerk scrutinizes the prescription. This calls attention to inaccuracies of the compounder in reading, or to omissions, wrong remedies, etc., during the compounding, thus lessening the liability to mistakes.

Many other plans for preventing mistakes in compounding have been proposed, and are practiced to some extent, such as the aggregation in one spot on the prescription counter of the original containers of all materials used, so that they may again be referred to; the use of poison closets, alarms, etc.; the frequent changing of order upon the prescription counter, so that the grasping of any material does not become habitual from long familiarity with its relative position.

All such plans have their advocates, and there are objections to all, but a system of checking by another, as above mentioned, is in general favor.

Mistakes of all kinds are best avoided by ATTENTION. Rarely is a mistake made in dispensing when the compounder has the possibility of a mistake in mind. The danger comes when the attention is divided between the prescription at hand and some foreign subject,— the latter receiving the greater portion of thought,— or when the prescription is not completely understood, and an unwarranted venture is assumed. *Mistakes are always a personal factor* and are best avoided by personal care.

The compounder should (1) Refuse to divide his attention when compounding. If attention to another matter is demand, it is better to note your position on the prescription at hand, then leave it absolutely for the necessary time, than to attempt to attend to both at the same time.

(2) Thoroughly read, and be sure you understand, every prescription before attempting to dispense it.

(3) When compounding, observe the label of every container used, at least *three times:* Once when taking it from the shelf or drawer; a second time, just before weighing or measuring; and a third time, before returning it to its proper place.

(4) Do not relax your attention until the medicine is in the customer's hands and the prescription properly filed away. When two or more prescriptions are compounded for the same person at the same time, the labels are liable to get mixed unless care is taken to prevent. Serious consequences may follow a mistake of this nature.

Methods of filing prescriptions vary with individual opinions. The method of pasting the original prescription in a book kept for that purpose, has the advantage of preserving the original, which may be a matter of some importance, but is not so neat, and any peculiarities or obscurities in a given prescription must be deciphered by each clerk individually, unless re-written or marked in some way. New clerks are thus forced to struggle, at times, with unfamiliar writing, and with less opportunity for assistance than is allowed with new prescriptions.

The method of copying each prescription into a special book is free from these objections, but any mistake in the first reading, or in re-writing, is perpetuated, and reference to the original may be impossible.

Whatever method is adopted, four things should appear on each prescription beside the data upon the original. The number, the selling-price of the medicine, the date (and name of the patient), and, in cases of difficulty, the order or manner of mixing, and any special manipulations which have been followed.

The purposes of the number and selling-price are obvious. The date and name of the patient make it possible to find any prescription, at any time, in case the number has been lost. This is a convenience which is due to, and will be appreciated by, the customer.

The data regarding methods of mixing and manipulations insure uniformity in the product, and obviate suspicions on the part of the customer.

The ownership of the prescription is a mooted question, which is best settled by the laws of courtesy and personal judgment. In one of the leading pharmacies of Boston the original prescription is never returned (if compounded), though copies are given when requested.

The reason given for this procedure is, that the original prescription is taken as legal evidence in cases of mistakes or any legal charge, while copies of the prescription have no standing in law. Lawsuits have been prevented by possession of the original.

In another prominent store the original prescription is always returned, and only a copy is preserved.

Probably the location of the store and the character of the trade have as much influence as any factor in such questions.

Perhaps very few stores, if any, refuse to give at least a copy of the prescription to the original possessor, when requested, but other persons should be refused, as a rule.

The renewal of prescriptions is also a question for individual judgment.

In the majority of cases renewals are expected and granted, on demand, but occasions sometimes arise where a single vial-full is all that is needed or advisable. The notion that a medicine "can do no harm, if it does no good," is in most cases erroneous, sometimes very decidedly so. Moreover, the pharmacist should remember that such conditions as are found in opium or cocaine habitues (not to say drunkards), often originate in the use of a prescription containing one of these drugs in some form, originally prescribed for a legitimate purpose, but renewed from time to time until the habit is established.

These conditions can be prevented by the pharmacist, if he exercises watchfulness.

Some method of marking such prescriptions by the physician, to prohibit renewal, has often been advocated, and is certainly desirable.

GENERAL SUGGESTIONS.

Invite customers to be seated while waiting for a prescription.

Study the prescription out of sight. Customers always think that the prescription is faultless and will suspect ignorance or incapability on the part of the compounder if he does not appear to understand it immediately.

Consult reference books freely, remembering that he is best educated who knows where and how to find information when he wants it. Education does not consist in the cramming of isolated facts, but in the power to apply principles.

If any part of the prescription is ambiguous, study the remainder to see if it cannot be revealed thereby. Oftentimes the directions will give a reliable clue to an ambiguous ingredient or quantity. Note the dots over the line as well as the marks underneath, in the quantity signs. Two j's may be so made as to appear like a v; the presence or absence of two dots over the line will settle the question in most cases.

A teaspoonful is usually figured as one drachm, but a fluidounce will commonly yield six or seven teaspoonful doses; rarely eight.

Two drachms may be written as two teaspoonfuls or as a dessertspoonful. Don't write "teaspoonsful."

Four drachms is a tablespoonful.

Two ounces means a wineglassful, four ounces a teacupful and eight ounces a tumblerful.

Be cautious about questioning the patient, lest he suspect both you and the doctor.

Don't be a catspaw for curious information concerning the doctor. Allay suspicion when you can, but do not encourage it. If asked what the ingredients are, give Latin, German or other obscure names. If questioned concerning its uses, say that it serves a variety of purposes. Use judgment at all times.

Compound privately. Results cannot always be foretold and the prescription may need to be compounded in two or three different ways before satisfactory results are obtained. It is better that the customer shall not witness these trials.

Keep the prescription, or a copy of it, before you while compounding. Never trust entirely to memory.

Compound promptly and expeditiously, but not hastily. Take pride in your skill.

Always pour from the *back* of stock-bottles and remove any drops adhering to the lip by touching with the stopper.

Use the smallest graduate that will hold the liquids.

For weighing extracts and sticky semi-solid bodies, a counterbalanced paper sprinkled lightly with lycopodium facilitates the operation.

For weighing semi-fluid bodies like ichthyol, balsam of Peru, balsam of fir, etc., a piece of parchment or waxed paper, formed into a cup by pressing over and around a cork, makes a convenient and economical receptacle. When the paper is reopened, a spatula will remove the last traces for compounding, and there is nothing to clean except the spatula.

Be neat in dispensing. The only criterion by which customers can judge of the quality of your drugs is the tastiness and care shown in dispensing. Be sure that utensils and bottles are clean, corks are whole, and that packages are wrapped neatly.

Write the label plainly and evenly. Remove any old labels, if the bottle is furnished, before pasting on a new one. If proprietary remedies are prescribed in original packages with special directions, remove the labels and substitute your own.

Never paste one label over another; neither will stick as well as when fastened to the bottle alone. Besides, it is unsafe.

Labels are easily removed after soaking in water. By fastening a piece of wet blotting paper or sponge over the label, by means of a rubber band, the soaking process can be effected while the bottle is being filled.

Flour, dextrin and tragacanth all make popular label-pastes; the last is perhaps as popular as any. Acacia makes the most adhesive mucilage, but is expensive. All need a very little oil of clove, oil of bay, carbolic acid, or other antiseptic agent, to keep them sweet.

Tragacanth paste should be made quite thin; 10 or 15 grains to an ounce of water, with about one drop of oil of clove. A more adhesive paste, which is adapted for use on tin, wood, or glass, is prepared by dissolving half an ounce of tragacanth and two ounces of acacia in half a pint of water. This is strained through cheesecloth to render it smooth, then seven grains of thymol dissolved in two fluidounces of glycerin are added, with enough water to make a pint of paste.

Dextrin makes a very limpid mucilage, and its adhesiveness is increased by acetic acid, — about quarter as much acetic acid as gum.

Flour makes the cheapest paste, but is somewhat troublesome to prepare. It must be well boiled. Rye flour, in the proportion of four ounces to a pint of water, is preferred. The addition of half an ounce of alum or a fluidrachm of nitric acid increases its adhesiveness.

An economical and thin mucilage, which is used by a number of pharmacists, is made by dissolving the residue which remains on the filter after making tincture of myrrh, in water. This residue consists almost entirely of gum, and is quite adhesive.

Butternut wood, says Mr. W. C. Durkee, makes the best surface for pasting. It absorbs the moisture quickly so that three or four dispensers can use it in common, without soiling the front of the labels. Accumulated paste on its surface is easily removed by washing with boiling water; once or twice a week being usually sufficient. Black walnut resembles it closely in appearance, but is not as good for this purpose. The board should, of course, be unvarnished.

Mr. Durkee uses a sliding board, set into the counter, for pasting. An inch or two of open space over the board allows of air circulation and the drying of the board. The paste-pot is a shallow ointment-pot set into a tin receptacle in the board, and then flat brushes lie in a groove beside the pot. This makes a convenient and cleanly arrangement, and avoids litter and unsightliness.

A piece of wire stretched across the top of an ointment-pot will serve to remove superfluous paste from the brush and keep the sides of the pot clean.

Paste the label evenly on the front of the bottle, a little above the center. All bottles, even round ones, have a front. Avoid an excess of paste. To smooth the label on the bottle place a piece of clean paper over it and rub. To make labels stick on tin coat the tin first with a thin layer of tincture of benzoin (or any resinous tincture) and let it dry; then use ordinary paste. Butter of antimony or glycerin may be used (sparingly) in place of the resinous coating, if preferred.

Poison labels except for liniments and purely external remedies, are best omitted from prescriptions, but shake labels may be used freely whenever there is any suspicion of their need.

Corks may be rendered absolutely impervious to ether vapor and extremely volatile liquids by soaking them in a hot 2½ per cent. solution of gelatin containing 5 per cent. of glycerin, then dipping into a solution of tannic acid. Tannate of gelatin is formed in the pores of the cork, and makes it absolutely impervious. Corks so prepared also fit better.

To render corks acid-proof soak them in melted paraffin. Both the gelatin solution and the paraffin must be *hot*, so that they can be absorbed by the cork. Paraffined corks are usually slippery, and need to be tied in.

The most valuable "stock in trade" of the prescription pharmacist is the confidence of the public. Tact and adroitness may preserve this under difficulties. Two incidents may illustrate:

A dispenser, while wrapping the bottle, suddenly remembered that one important ingredient of that prescription had been left in the balance pan. The customer was a nervous gentleman, who had implicit confidence in the compounder. To confess the carelessness would be a blow to the customer's faith, and would result in the loss of a valuable customer. To send the bottle away without this ingredient was even worse. But the accidental (?) dropping and breaking of the bottle settled the question. An apology and a second compounding followed, the customer had no suspicion of wrong, and the medicine was properly prepared.

In a second case, the messenger had left the store with the bottle of medicine before a similar mistake was discovered. The clerk who was sent to rectify the mistake managed to overtake the messenger, and in running against him caused the bottle to be dropped and broken. After an apology and a wordy argument, the medicine was again prepared, this time free of charge.

Use only clean utensils. There is a knack in cleaning, too. For graduates, a cleansing fluid, consisting of a solution of soap in diluted ammonia water, or potassa solution, is a convenient one at the sink, but it must not be used indiscriminately. Sawdust or powdered pumice makes a desirable addition for mortars. If soap is added directly to a graduate coated with tincture of chloride of iron, or any other metallic salt solution, an insoluble soap is at once formed on the glass which is not easily removed. It is always best to first rinse the measure in running water, then any adhering matter is more easily observed, and can be removed by proper means.

Resinous matter, oils, balsams, oleo-resins, carbolic acids, cresols, etc., are best removed by means of soap, or a cleansing fluid like the above, applied with a stiff brush.

Oleates, lead plaster, and similar metallic soaps, can be first dissolved in turpentine or kerosene, then this is removed with soap. Oil of turpentine aids in removing many odorous and sticky substances from mortars, graduates, etc.

Iodoform is removed, odor and all, by washing first with caustic potassa or soda, then rinsing with a little alcohol.

Metallic salts, if soluble, are rinsed out with water, aided, if needed, by a little nitric or hydrochloric acid. Diluted acids are best, and will sometimes be effective where strong acids fail.

Insoluble or slowly soluble salts may be decomposed by the appropriate reagent, or dissolved by another salt solution. (See table of compound solvents.) Ferrocyanide of iron, which stains mortars badly, is easily removed by caustic potassa.

Collodion and solution of gutta-percha, if undried, may be coagulated by a flow of water, a thin non-adherent film forming which is easily removed. If the film sticks, a mixture of ether and alcohol must be used for collodion, and chloroform for the gutta-percha. Goulard's solution and lime deposits are removed with weak acetic or nitric acids.

Greasy substances, ointments, etc., are easiest removed from tiles or mortars by scrubbing with sawdust. A box of sawdust kept in a handy place eases the labor of cleansing greasy utensils and containers wonderfully. The sawdust is returned to the box and used until it all is impregnated with grease, when it should be renewed.

Clean sawdust also furnishes a ready means of cleansing drug-mills, by running through the mill two or three times.

Next to sawdust soft paper is best for mortars and tiles. The last traces of grease are removed by solution of potassa, or by means of soap solution.

The quickest and easiest way to warm a mortar or tile for ointment or pill-making is to wet the inside with alcohol and set it on fire. Half a drachm of alcohol is sufficient as a rule. Do not have the pestle in the mortar while the alcohol is burning.

Shot is *not* the best thing for scrubbing bottles. It is composed of lead — a soft metal which easily wears away — containing a little arsenic. When shaken in a bottle streaks of lead may be left on the inside of the glass, which may act the part of an unwelcome reagent, if not otherwise objectionable. Professor Patch tells of a precipitate occurring from this cause in a mixture containing tincture of chloride of iron and diluted phosphoric acid. The traces of lead may be removed by rinsing with diluted nitric acid, but coarse sand is a better scrubbing agent. The sand is also handy to have (if clean) for use in percolating.

The best tests of cleanliness, which should always be applied to graduates and mortars, are the absence of odor, of taste in the last rinsings, and in the case of non-odorous metallic salts, particularly poisons, the failure of a test when the appropriate reagent is applied.

For bottles or utensils to be used for hypodermic injections, distilled water should be used for final rinsing, or, in case this is scarce and expensive, water which has been filtered through a porcelain bougie, like the Pasteur or Boston filters. Water so filtered affords a good substitute for distilled water in some cases — not in all, for it still contains dissolved matter.

For the quick filtration of collyria or other solutions, an aspirator is most effective and convenient, if permanent connections are made. A small Chapman aspirator, which is readily screwed on to a water-tap by means of a reducing-coupling, connected by rubber tubing with a bell-jar carrying a small funnel, and resting upon a greased plate, makes all the connections needed. When used, a plain-folded filter is placed in the funnel, a graduate or bottle is put underneath to catch the filtrate, a flow of water from the tap operates the pump, and the liquid is forced rapidly through the filter by air-pressure, the pressure coming, of course, from exhaustion of the air inside the bell-jar.

Such an arrangement is inexpensive, always ready for use, and can be utilized, particularly the aspirator portion, for other purposes. Small filters will stand the pressure without breaking, while large ones would need some reinforcement at the apex.

Holes can be cut in glass, corks, or rubber stoppers by means of a rat-tail file. For glass, wet the file with turpentine, or, better, a solution of camphor in turpentine. For rubber stoppers, wet the file with caustic potassa solution.

Drops obtained from the end of a stopper held against the lip are commonly larger than those obtained directly from the lip. But drops are always uncertain things. Don't forget to pour or drop from the *back* of the bottle, and keep the front and the label clean.

Gutta-percha makes a good mending tissue. A strip of it glued upon the sides of a funnel or graduate, over the crack, will preserve their usefulness. Heat will make it adhere to the glass so that it will not come off easily, and it is not affected by weak acids or alkalies. Equal parts of gutta-percha and shellac, melted together, make the strongest kind of cement for pestle-handles or for broken mortars. It should be applied quickly, and the mortar-edges or pestle should be warm.

A rubber pad or a piece of rubber sheeting under a mortar prevents slipping and saves much effort in holding the mortar steady. It is specially useful in making pill-masses, stiff ointments and emulsions. It also reduces noise.

A cylinder of tin (made from an old vaseline or tomato can), just large enough to set over the spirit-lamp, affords a good support for vessels to be heated, and keeps the heat where it is most wanted. Holes or slits must be cut in both the top and bottom of the cylinders, to allow a circulation of air, else the lamp will not burn. The freer the circulation the better the heat.

Broken spatulas, if there is a sufficiently long stub, are easily ground or filed into shape, and are useful in pill-massing or ointment-making.

Finally, all rules have their exceptions, but exceptions should not be made the rule.

TABLE OF LATIN TERMS USED IN PRESCRIPTIONS.

The more important, in heavy type, should be memorized by the student.

TERM OR PHRASE.	CONTRACTION.	MEANING.
Abdomen, inis	Abdom	The belly.
Ablutio, ionis		A washing, cleansing.
Absente febre	Abs. feb	In the absence of fever.
Accurate		Carefully, accurately.
Accuratissime	Accuratiss	Most carefully, most accurately.
Acerbitas, atis		Sourness.
Acerbus, a, um		Sharp, sour, harsh (to the taste).
Acetum saturninum		Solution of subacetate of lead.
Ad (prep. w. accus.)		**To, up to.**
Ad conciliandum gustum		To suit the taste.
Adde, addatur	**Add**	**Add (thou), let it be added.**
Addantur, additus		Let them be added, adding.
Addendus, addendo		Adding, for or by adding.
Adde cum tritu	Add. c. trit	Add with trituration.
Additis sub finem coctionis		Adding toward the end of boiling.
Ad defectionem animi	Ad. def. anim	To fainting.
Ad gratam aciditatem		To an agreeable sourness.
Ad gratum gustum		To an agreeable taste.
Adhibendus	Adhib	To be administered.
Adjacens		Near to.
Ad libitum	**Ad. lib**	**At pleasure.**
Admove, admoveatur		
Admoveantur	**Admov**	**Apply, let it or them be applied.**
Admoveantur durante dolore		Let it be applied when in severe pain.
Ad partes dolentes	Ad. part. dolent	To the painful (or aching) parts.
Ad secundam vicem	Ad. 2d vic	To the second time.
Adstante febre	Adst. febre	When the fever is on.
Adversum	Adv	Against.
Ætas, atis		Age, time of life.
Aggrediente febre	Aggred. feb	When the fever is coming on.
Agita, agitetur	**Agit**	**Shake, stir, let it be shaken or stirred.**
Agitato, agitando		With or by shaking, or agitation.
Agita ante sumendum		Shake before taking.
Agita donec refrigerat		Stir until it is cold.
Agitando miscentur		Let them be mixed by shaking.
Agitato vase	**Agit. vas**	**The vial being shaken.**
Albus, a, um	**Alb**	**White.**
Alcoholisatus, i		Alcoholized, *i.e.*, powdered extremely fine.
Aliquot		**Some, a few.**
Alimentum, i		Nutrient, nourishment.
Alter, alteram	Alt	The other, the rest.
Alternis horis		**Every other hour.**
Aluta		Leather.
Alvo astricta (*or adstricta*)	Alv ast	For confinement of the bowels (constipation).
Alvus		The belly, the bowels.
Amphora, æ		A pitcher, a jug.
Amplus	**Amp**	Large, ample.
Ampulla		A large vessel.
Ana	**ā ā**	**Of each.**
Ante		**Before.**
Applica, applicetur		Apply, let it be applied.
Aqua aërata	**Aq. aerat**	Carbonated water.
Aqua astricta	Aq. ast	Frozen water, ice.
Aqua bulliens	**Aq. bull**	**Boiling water.**

Term or Phrase.	Contraction.	Meaning.
Aqua fervens	**Aq. ferv**	**Warm water.**
Aqua communis	Aq. com	Common water.
Aqua fontis (fontalis or fontana)	**Aq. font**	**Spring water.**
Aqua gelida		Cold water.
Aqua marina	Aq. mar	Sea water.
Aqua phagedænica	Aq. phaged	Yellow wash.
Aqua pluvialis	Aq. pluv	Rain water.
Aqua potabilis		Drinkable water.
Aqua saturni	Aq. satur	Subacetate of lead water.
Aqua urbis	Aq. urb	City water.
Aquila alba		Calomel.
Argilla, æ		Clay.
Aut		**Or.**
Bacca, æ		Berry.
Bacillum, i		A bougie.
Balneum		**A bath.**
Balneum arenæ	Bal. ar.	Sand-bath.
Balneum maris	Bal. mar	Salt (or sea) water bath.
Balneum vaporis	Bal. vap	Steam (or vapor) bath.
Bene		**Well, good.**
Bibe, bibatur		Drink, let it be drank.
Biduum		Two days.
Bis		**Twice.**
Bis in die, bis in dies, bis intra diem	**Bis in d**	**Twice a day.**
Bonus, a, um		Good.
Brachium		An arm.
Brevis		Short.
Bulliat, bulliant	Bull	Let it (or them) boil.
Butyrum		Butter.
Cæruleus, i	Cærul	Dark blue, dark green.
Calefactus, i	**Calef**	**Warmed.**
Calido solvuntur		Let them be dissolved while hot.
Calomelas or calomelanos	Calom	Calomel.
Calor, oris	Calor	Heat, warmth.
Capiat	**Cap**	**Let the patient take.**
Capiat omnes cursu hodie		Let the patient take all during this day.
Capiat quantum vis. (or volueris)	**Cap.quant.vis.**	**Let the patient take as much as he will.**
Capillus, i		The hair.
Capsula, æ	**Caps**	**A capsule.**
Capsulæ amylaceæ		**Amylaceous capsules, i. e. cachets.**
Caput, capitis		The head, of the head.
Carbasus, i	**Carbas**	**Linen, lint.**
Caro, carnis		Meat, of meat (flesh).
Cataclitum, i		A pillow.
Cataplasma, atis		A poultice.
Catharticum, i		A cathartic.
Caute		**Cautiously.**
Celeriter		**Quickly, immediately.**
Cena (or cæna or cœna)		Supper.
Ceratum, i		**A wax salve.**
Charta	Chart	Paper.
Charta Bibula	Chart. Bib	Blotting paper.
Charta cerata	**Chart. cerat**	**Waxed paper.**
Charta densata		Paste-board.
Charta exploratoria		Reagent or Litmus paper.
Charta stannata		Tinfoil.
Chartula	**Chart.**	**A small paper.**
Chininum	Chinin	Quinine.

Term or Phrase.	Contraction.	Meaning.
Cibus, i		Food, victuals.
Circitu		Near, round, about.
Cito		Quickly.
Cito dispensetur!	**Cito disp.!**	**Let it be dispensed quickly.**
Clarus, a, um		Bright, clear.
Clausus, a, um		Closed, inclosed.
Cochleare, cochleatim	Coch	A spoonful, by spoonfuls.
Cochleare amplum, or magnum	**Coch. amp** **Coch. mag**	**A tablespoonful.**
Cochleare medium or modicum	**Coch. med**	**A dessertspoonful.**
Cochleare parvum	**Coch. parv**	**A teaspoonful.**
Coctio		Boiling.
Cogantur		Let them be combined.
Cola, coletur, colentur		**Strain, let it (or them) be strained.**
Colaturæ (*dat.*)	Colatur	To or of strained liquor.
Collum, i		The neck.
Collunarium, i		**A nose-wash.**
Collutorium	**Collut**	**A mouth-wash.**
Collyrium	**Collyr**	**An eye-lotion.**
Coloretur		Let it be colored.
Commisce, commiscetur, commiscentur		Mix together, let it or them be mixed together.
Commode (*adv.*)	Commod	Rightly, properly, suitably.
Concisus		Cut.
Concussus, i		Shaken.
Concute, concutiatur		Shake, let it be shaken.
Conditum, i, um		Candied.
Conditum, i		A confection, comfit.
Confricamentum, i		A liniment for rubbing.
Congius	**Cong**	**A gallon.**
Conquassando		By vigorous shaking.
Conserva		A conserve; also preserve.
Consperge, conspergetur	Consperg	Dust or sprinkle, let them be sprinkled or dusted.
Contere, conterantur	Contere	Rub together, let them be rubbed together.
Conterendo		With or by rubbing together.
Continuantur remedia	Cont. rem	Let the medicines be renewed.
Contra		**Against.**
Contritus, a, um	Contrit	Broken, ground, crumbled.
Contusus, a, um	**Contus**	**Bruised.**
Coque, coquetur, coquantur	**Coq**	**Boil, let it (or them) be boiled.**
Coquantur simul	Coq. simul	Boil together.
Cor, cordis		The heart.
Cotula, æ		A measure.
Coxa		The hip.
Cras, crastinus	Cras	To-morrow.
Cras sumendus		To be taken to-morrow.
Cras mane		To-morrow morning.
Cras nocte		To-morrow night.
Cras vespere		To-morrow evening.
Cujus, cujus libet	**Cuj., cuj. lib**	**Of which, of whatever you please**
Cum	C	**With.**
Cum guttis aliquot		With a few drops.
Cursu (*abl.*)		In the passing of, during.
Cyathus, or	Cyath	
Cyathus vinarius	Cyath. vinar	A wineglass.
Da, detur, dentur	**Da, det., dent.**	**Give, let it (them) be given.**
De (*prep. w. abl.*)		From, down.
Deaurentur		Let them be gilded.

d.t.d - dentur tales doses

[illegible]

TERM OR PHRASE.	CONTRACTION.	MEANING.
Debitæ spissitudonis	Deb. spiss.	To a proper consistence.
Debitus, a, um		Due, proper.
Decanta		Decant.
Decoctum	Decoc.	A decoction.
Decoque, decoquetur, decoquentur		Boil down, let it be boiled down.
Decubitus	Decub.	Lying down.
De die in diem	De d. in d.	From day to day.
Dein, deinde		Afterward, then.
Deglutiatur (antur.)		Let or may be swallowed.
Dejicerit, dejiciatur		Will purge, let it be purged.
Dexter		Right.
Diebus alternis	Dieb. alt.	Every other day.
Dies (diei, gen.)	D.	A day.
Digere, digeretur, digerentur		Digest, or let be digested.
Diluculum, i, diluculo		Daybreak, at dawn.
Dilue, dilutus, a, um		Dilute, diluted.
Dimidius, a, um	**Dim.**	**One-half.**
Directiones	Dir.	Directions.
Directione propria	Dir. prop.	With proper directions.
Dispensa, dispensetur	Disp.	Dispense, let it be dispensed.
Divide, dividatur, dividantur	**Divid.**	**Divide, let be divided.**
Dolor, dolore		Pain, in pain.
Donec		Until.
Donec alvus dejecerit		Until the bowels move.
Donec alvus commode purgetur		Until the bowels are properly purged.
Donec alvus soluta fuerit		Until the bowels are loosened.
Donec habeas colaturæ		Until you have of strained liquor.
Donec leniatur dolor		Until the pain is relieved (or assuaged).
Donec sint residuæ		Until there is —— of residue.
Dosis		**A dose.**
Dulcedo (idinis) dulcitas, atis	Dulc.	Sweetness.
Duplico		In duplicate.
Eadem (fem.)		The same.
Edens, ntis		Eating.
Ejusdem		**Of the same.**
Electuarium	Elect.	An electuary.
Emesis		Vomiting.
Emplastrum ad clavas		Corn plaster.
Emplastrum conglutinans		Sticking plaster.
Emplastrum magdaleone		Plaster in rolls.
Emplastrum epispasticum	Emp. episp.	A blistering plaster.
Emplastrum vesicatorium	Emp. vesic.	
Emulgens, entis		An emulsifying agent.
Enema, enemata	Enem	A clyster. (Injection for the rectum.)
Epistomium	Epistom	A stopper, bung.
Et		**And.**
Etiam		Also, besides.
Etiam nunc		Yet, also, besides.
Evanuerit		Shall have passed away, disappeared.
Ex or E (w. alb.)	**e**	**From, out of.**
E qua formentur		From which are formed.
E quibus sumatur		From which are given.
Exhibeatur	Exhib.	Let it be exhibited (administered).
Ex modo prescripto	**E. m. p**	**After the manner prescribed (as directed).**
Ex paululo aquæ		From (or in) a very little water.
Experime		Try (thou).
Ex parte		Partly.
Exprime, exprimatur		Express, let it be expressed.

Term or Phrase.	Contraction.	Meaning.
Extende, Extendatur		Spread, let it be spread.
Extende super alutam	Extend sup. alut.	Spread upon leather.
Extende super pannum		Spread upon cloth.
Extrahe, extrahatur		Extract (thou), let it be extracted.
Extractum	Ext.	An extract.
Fac, fit, fiat, fiant	**Ft.**	**Make, let be made.**
Facere		To make.
Farina		**Flour, meal.**
Fasciculus	Fascic.	A little bundle.
Febris		Fever.
Febre durante		During the fever.
Femoris interni	Fem. inter	To the inner thigh.
Fervens (entis)	**Ferv.**	**Hot.**
Fictilis, e		An earthern vessel.
Filtra	**Filt.**	**Filter.**
Filtrum	Filt.	A filter.
Filtrum chartæ		Filter paper.
Flavus, a, um	**Flav.**	**Yellow.**
Fluidus, a, um	Fld	Fluid.
Flores benzoes		Benzoic acid.
Flores cinæ		Santonica.
Flores zinci		Oxide of zinc.
Folius, i	Fol	A leaf.
Fomentum, i		A fomentation. Stupe.
Formentur	Form	Let them be formed.
Frigor, oris	Frig.	Cold.
Frustillatim (adv.)	Frust.	In small pieces, little bits.
Fuerit		Shall have been.
Fuscus a, um		**Brown, dark.**
Gargarisma	Garg.	A gargle.
Gelatina		Gelatin.
Gradatim		**Gradually.**
Granum, grana	Gr.	**A grain, grains.**
Gratus, a, um		Pleasant, agreeable.
Grossus, a, um		Large, coarse.
Gummi mimosæ		Gum arabic.
Gutta, Guttæ	**gtt**	**A drop, drops.**
Guttatim		By drops.
Harum pilularum		Of these pills.
Harum pulverum		Of these powders.
Haustus, i	**Haust.**	**A draught.**
Hebdoma, æ		A week, for a week.
Herba, æ		An herb.
Heri		Yesterday.
Hora		An hour.
Hora decubitus	Hor. dic.	At bed-time.
Horis intermediis	Hor. interm.	In the intermediate hours.
Hora somni	**Hor. som.**	**At bed-time.**
Horæ unius spatio		At the end of an hour.
Idem		The same.
Identidem		Repeatedly, often.
Idoneus, a, um		Suitable, convenient.
Idoneo vehiculo	Idon. vehic.	In a suitable vehicle.
Illico		Then, immediately.
Illico lagena obturatur		Let the bottle be stoppered immediately.
Immitatur, immitantur		Let it (them) be introduced into, placed in.
In		**In, within, upon—(sometimes) not.**
Imprimis		Chiefly, first.

TERM OR PHRASE.	CONTRACTION.	MEANING.
Incide, incisus		Cut, cutting.
Inde		Therefrom.
Indies		Daily.
Infunde		Put or pour in.
Ingere, ingerendus		Put or force into, forcing into.
Ingerendo capsulas gelatinosas		Putting into gelatine capsules.
Injiciatur	Injic.	Let it be injected.
In impetu effervescentiæ		In the height of effervescence.
In lagena bene obturata		In a well-stoppered bottle.
In loco frigido	In loco frig.	In a cold place.
In massam subigantur		Let them be kneaded into a mass.
In massam cogantur		Let them be combined in a mass.
In olla ferrea vitreata		In a glazed iron pot.
In partes æquales		Into equal parts.
In pulmento		In gruel.
Instar		The form and size of.
In vaso clauso		In a closed (covered) vessel.
In vaso leviter clauso		In a loosely closed vessel.
Inter, internus		**Between, inner.**
Involve, involvuntur		Cover (coat), let them be covered.
Involve gelatina		Coat with gelatin.
Invergantur		Let them be moistened, sprinkled.
Ita		In such manner.
Iteretur, iterentur		Let it (or them) be repeated.
Jam		Now.
Jentaculum, i	Jentac.	Breakfast.
Jucunde	Jucund.	Pleasantly.
Julepum	Jul.	A julep.
Juscellum		A broth.
Juscullum		Soup.
Juxta, juxtim		Near to, nigh, close by.
Kalium	**K.**	**Potassium.**
Kali		Potassa.
Kali præparata		Potassium carbonate.
Lac, lactis		**Milk, of milk.**
Lagena, æ		A bottle.
Lamella, æ, lamina, æ		Plate, leaf, layer, scale.
Lana, æ		Flannel, wool.
Languor, oris		Faintness, feebleness.
Lapideus, a, um	Lapid	Of stone, stony.
Lapis infernalis		Silver nitrate, lunar caustic.
Largus, a, um		Abundant, plentiful.
Laridum, lardum		Lard.
Latus, a, um		Broad, wide.
Latus, eris (lateris)		The side, of the side.
Latere admoveatur	Lat. admov.	Let it be applied to the side.
Lateri dolenti	Lat. dol	To the painful side.
Laxamentum ventris		Purging, evacuating.
Laxus, a, um		Loose, open (opp. to astricta).
Lectus, i		A bed, couch.
Leniter		Easily, gently.
Leniter terendo		By rubbing gently.
Leviter		**Lightly.**
Leviter clausus		Lightly closed.
Linctus, i		A linctus or lohoch.
Linimentum, i		A liniment.
Lintum, i		Lint.
Liquor, oris	Liq	A liquor.
Luteus, a, um	**Lut.**	**Yellow, golden yellow.**
Macera, maceretur, macerentur	Macer.	Macerate, let it (them) be macerated

Term or Phrase.	Contraction.	Meaning.
Macera, donec refrigerant		Macerate until cold.
Macera per horas tres		Macerate three hours.
Macera per sextam horæ partem		Macerate ten minutes (one-sixth part of an hour).
Magdaleon, ntis		A roll.
Magnus, a, um	**Magn**	**Large.**
Mane (indeclin.)		Morning, in the morning.
Mane bene, mane plane.		Early in the morning.
Mane primo		
Manipulus, i.		A handful (bundle).
Manus, i.		The hand.
Mare, maris		The sea, of the sea, also sea-water.
Massa, æ	**Mass**	**A mass.**
Matula		A vessel, pot (for liquids).
Matutinus, a, um		In or of the morning.
Medius, a, um	Med.	Midst, middle, medium.
Mensura		By measure.
Mica, æ		A crumb, morsel.
Mica panis	Mic. pan.	Crumb of bread.
Minimum, i	m.	A minim.
Minutum, i		A minute.
Misce, misceatur, misceantur	**M.**	**Mix, let it (them) be mixed.**
Misce accuratissime	M. accur.	Mix very intimately.
Misce bene	M. bene	Mix well.
Misce caute	M. caute.	Mix cautiously.
Misceatur fortiter conquassanda		Let it be mixed (with) violent agitation.
Mistura	**Mist.**	**A mixture.**
Mitte, mittatur, mittantur		**Send, let it (them) be sent.**
Mitte tales		**Send of such, send like this.**
Modicus, a, um.		Moderate (sized), middling.
Modo dictu	**M. dict.**	**As directed (in the way said).**
Modo præscripto	**M. p.**	**As directed or prescribed.**
Mollis, is		**Soft.**
Mora, æ		A delay.
More dictu	**Mor. dict.**	**In the manner said (as directed).**
More solitu	Mor. sol.	In the accustomed manner.
Mos, moris		Manner, of manner, custom, work.
Mortarium, i	Mortar.	A mortar.
Natrium, i		**Sodium.**
Ne tradas sine nummo	Ne. tr. s. n.	Do not deliver unless paid.
Necnon		And also, and yet.
Niger, nigra, nigrum		**Black.**
Nihilum album	Nihil. alb.	Zinc oxide.
Nisi		Without, unless.
Non		Not.
Non repetatur	**Non rep.**	**Do not repeat.**
Novus, a, um		New, fresh.
Nox, noctis		Night, of the night
Noxa, æ, or *noxia, æ*		An injury, hurt.
Nucha		The nape of the neck.
Numerus, i		Number.
Numero	No	In number.
Nunc		Now.
Nutricius (nutritus), a, um		Nourishing, nutritious.
Nutritus, us		Nourishment.
Nux, nucis		Nut, of a nut.
Obduce, obducatur		Cover or conceal, let it be covered or concealed.
Obducantur foliis argenti		Coat (cover) with silver.
Obductus, a, um		Covered, concealed, coated.

Term or Phrase.	Contraction.	Meaning.
Obtritus, a, um		Crushed.
Occlusus, a, um		Enclosed.
Octarius	**O.**	**A pint.**
Octuplus, octuplo	Octup	Eight-fold — in eight-fold.
Oculus, i.		The eye.
Odoramentum, i.	Odoram	A perfume.
Odoratus, a, um	Odorat.	Odorous, smelling, perfuming.
Odora, odoretur		Perfume, let it be perfumed.
Oleosus, a, um		Oily.
Oleum—sine igne		Cold drawn or pressed — oil.
Olla, æ		A pot, jar.
Ollicula, æ		A little pot.
Omnis		**All, every.**
Omni hora	Omn. hor	Every hour.
Omni mane	Omn. man	Every morning.
Omni nocte	Omn. noct	Every night.
Optimus, a, um	**Opt.**	**Best.**
Opus (*indecl.*)		Need, necessity.
Oryza.		Rice.
Os, oris		The mouth, of the mouth.
Ovi putamen (*inis*)		An egg shell.
Ovum, i.		An egg.
Pabulum, i.		Food, nourishment.
Pallidus, i.		Pale, pallid.
Panis, i.		Bread.
Pannus, i, pannulus, i.		A cloth, rag.
Para, parita, paretur, paratus, i		Prepare, let be prepared, prepared.
Paretur inde.		Let be prepared therefrom.
Pars, partis, parti		A part, of the part, to the part.
Pars affecta fricetur		Let the affected parts be rubbed.
Parte affecta fricetur.		Rub upon the affected part.
Partes æquales	**P. e.**	**Equal parts.**
Partitus, a, um		Divided.
Partitis vicibus.		In divided doses.
Parvus, a, um, parvulus, a, um		**Little, very little, an infant.**
Pastillus, i		A pastille, lozenge.
Paucus, a, um, paucies (*adv.*)		Little, few, seldom.
Paulatim		Little by little, gradually.
Pectus, oris		The breast.
Penicillum, i, peniculus, i		A pencil, brush, little roll.
Per (prep. w. acc.)		**Through, by means of, very.**
Peractus, a, um		Finished.
Percalefactus, a, um		Thoroughly heated.
Percola, percoletur.		**Strain through, percolate, let be strained through.**
Perge, pergetur		Proceed with, continue, let be continued.
Perinde.		In the same manner, just as.
Perpurus, a, um		Very clean.
Pervesperi (*adv.*)		Very late in the evening.
Pes, pedis, pedi.		The foot, of, to, the foot.
Pessarium, i. *Pessulum, i.*	Pess.	A pessary.
Phiala, æ	Ph.	A phial.
Phiala prius agitata	P. p. a.	The vial having first been shaken.
Pilula, æ.		A pill.
Pilus, i		The hair.
Pinguis, is.	Ping	Fat, grease.
Pistillum, i.		A pestle.
Placebo		**I will satisfy (will please.)**

TERM OR PHRASE.	CONTRACTION.	MEANING.
Plasma, atis (n.)		A form, figure. (Glycerite of starch.)
Plasma, plasmetur		Mould (thou), let it be moulded.
Plenus, a, um		Filled.
Poculum, i, pocillum, i.		A drinking cup, a little cup.
Pomatum, i		A pefumed ointment.
Pondere		**By weight.**
Pondus, eris, ponderatus, i		A weight, weighing.
Pondus civile		Avoirdupois weight.
Pondus medicinale		Apothecaries' weight.
Post cibo	**Post cib.**	**After eating.**
Postridie		On the next day, the following day.
Potus, us		A drink, a drinking.
Præ (prep. w. abl.)		**Before, also very.**
Prandium, i.	Prand.	Dinner.
Pridie		On the day before.
Primus, a, um		First, earliest, beginning.
Pro (adv. and prep. w. abl.)		For, in favor of, before, according to.
Pro dose		**For a dose.**
Proprius, a, um		Special, particular.
Pro ratione ætatis		According to the condition of age, *i.e.*, according to the age of the patient.
Pro re nata	**P. r. n.**	**As occasion arises, occasionally, as needed.**
Pro potu cathartico		For a cathartic drink.
Proximo	Prox.	Nearest.
Prius (adv.)		Before, former.
Pugillum, i	Pugil.	A pinch.
Pulpa, æ		Pulp.
Pulvis, eris	**Pulv.**	**A powder.**
Pulvis grossus	**Pulv. gros.**	**A coarse powder.**
Pulvis subtilis or		
Pulvis subtilissimus	Pulv. subtil.	A smooth (very smooth) powder.
Pulvis tenuis or	**Pulv. tenu.**	**An extremely fine.**
Pulvis tenuissimus		**(Attenuated) powder.**
Purgativis, i	Purg.	A cathartic, purging.
Purus, a, um.	**Pur.**	**Pure, clean.**
Pyxis, idis		A small box, a pill box.
Quadrans, antis		A fourth, quarter.
Quadrum, i		Square.
Quadruplo		In four-fold, quadruple.
Quam (adv.)		As much as, in what manner.
Quam libet		
Quam (or qua) vis (volueris)	q. v.	**As much as you wish.**
Quantum libet	q. l.	As much as you please.
Quantum placet	q. p.	
Quantum vis or volueris	q. v.	
Quantum sufficit	**q. s.**	**A sufficient quantity.**
Quantum satis		
Quaqua hora		Every hour.
Quaque, quisque	q. q.	Each, every.
Quartus, i		Fourth.
Quibus		To or from which.
Qui libet		Any, whatever you please.
Quisquam or quisquis		Anything.
Quoque	q. q.	Also.
Quorum		Of which.
Quotidie		Daily.
Quoties		As often as.
Quoties requiritur		As often as is required.
Rarus, a, um		Loose, thin, rare.

TERM OR PHRASE.	CONTRACTION.	MEANING.
Ratio, onis		Relation, proportion, condition.
Recens, ntis	**Rec.**	**Fresh, recent, newly.**
Recipe	**℞.**	**Take (thou). A recipe.**
Redactus, i	Redact	Reduced.
Reductus in pulverem	Red in pulv	Reduced to powder.
Regio, onis		Region, direction, portion.
Relectus, a, um		Opened, loosened.
Reliquus, i	Reliq	Remaining, the remainder.
Renova, renovetur		Renew, let it be renewed.
Renovetur semel	Renov. semel.	Let it be renewed once only.
Repetatur, repetantur	Rept	Let it (or them) be repeated.
Res, rei		A thing, object, substance, affair.
Residuus, a, um		Residual, remaining.
Retineatur		Let it be withheld.
Rictus, us		Wide open, distended.
Rigidus, a, um		Rigid, hard, inflexible.
Rotula, æ		Globules.
Ruber, rubra, rubrum	**Rub.**	**Red, ruddy.**
Rudicula, æ		A spatula.
Rudis, is		A stirring rod.
Rumen, inis		The throat.
Saccellatio, onis		A sack, a dry poultice.
Saccelus, i		A medicated sack — a pad.
Saccharum saturni		Acetate (sugar) of lead.
Sæpis, sæpe		Often, frequently.
Sal, salis	Sal	Salt, also shrewdness.
Sal amarum		Magnesium sulphate.
Sal mirabile		Sodium sulphate.
Saltem		At least.
Sanguis (inis), sanguineus		Blood, bloody.
Saponamentum, i		An opodeldoc.
Sapor, is		A flavor, delicacy.
Satis, is		Enough, sufficient.
Scapulæ, arum		The shoulder blades.
Scatula, æ	Scat.	A box.
Scrupulus, i	Sc. or ℈.	A scruple.
Scutum, scuto		Protection, for protection.
Scuto pectori		For protection to the breast
Secundo		Secondly, in order.
Secundum artem	**s. a.**	**According to art.**
Secundum legem	**s. l**	**According to law.**
Semel		Once, a single time.
Semi, semis	**ss.**	**A half, half.**
Semihora		Half hour.
Sensim		Gently, gradually, slowly.
Seorsum		Sundered, apart, separate.
Separatim	Separ	Separately.
Septimana		A week.
Sericum, i		Silk.
Sericum adhæsivum		Silk court-plaster.
Sericum oleatum		Oiled silk.
Sero		Late, at a late hour.
Sesuncia		An ounce and a half.
Sesqui		**Once and a half.**
Sesquihora		An hour and a half.
Sevum, i		Suet, tallow.
Sextans (ntis), sextus		Sixth-part, sixth.
Si		**If.**
Sic!		So, in this manner, thus.
Sicca, Siccetur		Dry, let it be dried, or drained.

Term or Phrase.	Contraction.	Meaning.
Siccus		Dry, dried.
Signa, signetur	**Sig**	**Mark, imprint (thou). Let it be imprinted.**
Signanter		Clearly, distinctly.
Sile hujus!		Keep (thou) silence concerning this!
Simplex, simplicis	Simp	Simple, unmixed.
Simul		**Together.**
Sinapismus, i		A mustard poultice, sinapism.
Sine	**s**	**Without.**
Sine expressione	S. expr	Without expressing, pressing.
Singillatim, singularis		One by one, singly.
Singulorum	Sing.	Of each.
Si non valeat	Si. n. val	If it does not answer,—be of value.
Si opus sit	**Si. op. sit**	**If it is best,—needed.**
Si vires permittebant	Si. vir. perm	If the strength will permit.
Sit		Let it be.
Sit in promptu		Let it be in readiness.
Sitis (is), siti		Thirst, for thirst.
Solatium, ii		Soothing, assuaging.
Solitus, a, um		Accustomed, ordinary.
Solus		Alone, only.
Solve, solvatur	**Solv**	**Dissolve, let it be dissolved.**
Solutus, solutio, onis	**Sol. or solut**	**Dissolved, solution.**
Soluto tandem		To or in the solution finally.
Solve cum leni calore		Dissolve with a little heat.
Somnus		Sleep.
Sparadrapus, i		A spread plaster.
Spiritus vini rectificatus	**S. V. R**	**Alcohol.**
Spiritus vini tenuis	**S. V. T**	**Proof spirit.**
Spissitudo, inis		Thickness, consistency.
Spissus, a, um	Spiss	Dense, hard.
Statim		Immediately, at once.
Stet, stent		Let it or them stand.
Stibium, i		Antimony.
Stillatim		By drops, in small quantities.
Stilus		A stake, crayon.
Stomachus, i		The stomach, alimentary canal, gullet.
Stratum, i		Layer, stratum.
Suavis		Pleasant, agreeable.
Sub		**Under, somewhat.**
Subactus		Subdued, sinking.
Sub finem coctionis		Toward the end of boiling.
Subigatur, subigantur		Let it (them) be subdued, overcome.
Subinde		Frequently.
Subtilis		Fine, smooth, nice.
Succus, i		Juice, sap.
Suggillationi		To the bruise.
Sume, sumat, sumantur, sumatur, sumendus	**Sum**	**Take or employ, or consume. Let him take, let it be taken, to be taken.**
Sumat talem	Sum. talem.	Let the patient take — like this.
Summo mane sumendus		To be taken very early in the morning.
Summus, a, um		Highest, summit.
Super		**Above, upon, over.**
Superbibe		Drink afterwards.
Suppositoria, æ	Suppos	A suppository.
Suppositoriæ rectales	Suppos. rect	Rectal suppositories.
Suppositoriæ urethrales	Suppos. ureth.	Urethral suppositories.
Syrupus fuscus		**Brown syrup, i. e., molasses.**
Tabella, æ	Tab	A tablet, lozenge.

TERM OR PHRASE.	CONTRACTION.	MEANING.
Talis, is.		**Of such, like this.**
Tam		So far, in so far.
Tandem		At last, finally.
Tantum, i		So much, so many.
Tegmen, or Tegumen, inis.		A cover.
Tempus, oris		Time.
Tenuis.		Fine, weak, thin.
Tepidus, a, um		Tepid, lukewarm.
Ter		**Thrice, three times.**
Ter in die	**t. i. d**	**Three times a day.**
Tere, teretur		**Rub, triturate. Let it be rubbed.**
Teres, etis		Rubbed, smooth, polished.
Tere simul.	**Ter. sim**	**Rub (triturate) together.**
Testa, æ		A shell.
Testa ovi		An egg shell.
Thion, Thionas, atis		**Sulphur, sulphate.**
Tinctura thebaica		Laudanum, tincture of opium.
Triplico	Trip	Triplicate.
Tritura, trituretur	**Trit**	**Triturate, let it be triturated.**
Trochiscus	Troch	Troche, lozenge.
Tum		Then, next, furthermore.
Turbidus, a, um		Turbid, muddy, not clear.
Tussis, is		A cough.
Tuto		Safely.
Ubi		Where, wherever, whenever.
Ulna, æ		The arm, or elbow.
Ultime, ultima	**Ult**	**Lastly, at the last.**
Ultimo præscriptus	Ult. præsc	The last ordered.
Una		To one, together.
Uncia, æ		**An ounce.**
Unctulus, a, um, unctus, a, um		Besmeared, anointed.
Unctus, us		An anointing, anointment.
Unguentum, i	Ung	Ointment, unguent.
Unguilla, æ		An ointment-box.
Urgens, entis		Pressing, urgent.
Ustus, a, um		**Burned.**
Ut or *uti*		That, so that, in order that.
Ut dictum	**Ut dict**	**As directed.**
Utere, utendus, i		Make use of, to be used.
Utendus more solito	Utend. mor. sol.	To be used in the usual manner.
Vapor, oris		Steam, vapor.
Vas, vasis		A vessel, utensil, bottle.
Vas vitreum	Vas. vit	A glass vessel.
Vehiculum, i	Vehic	A vehicle.
Vel (or ve as a suffix)		**Or.**
Venenosus, a, um, venenum, i.		Poisonous, a poison.
Verus, a, um		**True, real, genuine.**
Vesper, eris		The evening.
Vesperma, æ		Supper.
Vicis, is, vices		Change, alternation, turns.
Viridis, is, viride, is		**Green.**
Vis, viris		Strength, vigor, life.
Vitreus, a, um		Of glass, glazed.
Vitrum, i		Glass.
Volatilis, is, volatile	**Volat**	**Volatile.**
Vomito, onis, Vomitus, us		Vomiting.

NUMERALS.

Cardinals.		Ordinals.	
Unus	One.	*Primus*	First.
Duo	Two.	*Secundus*	Second.
Tres	Three.	*Tertius*	Third.
Quatuor	Four.	*Quartus*	Fourth.
Quinque	Five.	*Quintus*	Fifth.
Sex	Six.	*Sextus*	Sixth.
Septem	Seven.	*Septimus*	Seventh.
Octo	Eight.	*Octavus*	Eighth.
Novem	Nine.	*Nonus*	Ninth.
Decem	Ten.	*Decimus*	Tenth.
Undecim	Eleven.	*Undecimus*	Eleventh.
Duodecim	Twelve.	*Duodecimus*	Twelfth.
Tredecim	Thirteen.	*Tertius decimus*	Thirteenth.
Quatuordecim	Fourteen.	*Quartus decimus*	Fourteenth.
Quindecim	Fifteen.	*Quintus decimus*	Fifteenth.
Sexdecim	Sixteen.	*Sextus decimus*	Sixteenth.
Septemdecim	Seventeen.	*Septimus decimus*	Seventeenth.
Octodecim or duo de viginti	Eighteen.	*Octavus decimus*	Eighteenth.
Novemdecim or un de viginti.	Nineteen.	*Nonus decimus*	Nineteenth.
Viginti	Twenty.	*Vicesimus*	Twentieth.
Viginti unus or unus et viginti	Twenty-one.	*Vicesimus Primus*	Twenty-first.
Triginta	Thirty.	*Tricesimus*	Thirtieth.
Quadraginta	Forty.	*Quadragesimus*	Fortieth.
Quinquaginta	Fifty.	*Quinquagesimus*	Fiftieth.
Sexaginta	Sixty.	*Sexagesimus*	Sixtieth.
Septuaginta	Seventy.	*Septuagesimus*	Seventieth.
Octoginta	Eighty.	*Octogesimus*	Eightieth.
Nonaginta	Ninety.	*Nonagesimus*	Ninetieth.
Centum	One hundred.	*Centisimus*	Hundredth.

CHAPTER III.

NOMENCLATURE.

The temptation to physicians to abbreviate in writing prescriptions makes it necessary that the pharmacist should be thoroughly conversant with chemical nomenclature, particularly in regard to those bodies which are most frequently prescribed as remedies.

A salt or chemical may be known by several names, — its trade or common name, its Latin or scientific name, and in many cases also by a technical or descriptive name.

The common or trade name may have been derived from the names of those who first brought them into notice, as Glauber's or Signette's salt, or from the place from which they were first obtained, as Epsom or Rochelle salt. The Latin or scientific names designate, in a general way, the chemical composition of the bodies, and when there are a number of salts or bodies which contain the same elements, but in different proportions, more definitely descriptive names may be applied to them to avoid confusion.

Thus, "chloride of mercury" may mean either calomel or corrosive sublimate, but the terms *mild* chloride of mercury and *corrosive* chloride of mercury, *proto*chloride of mercury and *bi*chloride of mercury are definite, and cannot be confused.

The first of these terms gives a general idea of the salt, — composed of mercury and chlorine; the second distinguishes between the medicinal and physical action of two chlorides which exist, one being "mild," and the other "corrosive"; the third of the terms also distinguishes between the two chlorides, one being the "proto" (first or lowest) chloride, and the other the "bi" (second or higher) chloride.

Unfortunately, no one system of nomenclature is satisfactory for all, and much confusion may arise unless the dispenser understands the principles which underly each system. A single body may have several trade-names, and the Latin title may be thought too long.

The third term attaches certain prefixes or suffixes to the negative (acid) term, which have a constant meaning, and thus distinguish the salt clearly from others of a similar composition. This method may be used for all definite chemical compounds, but if carried out in some cases, ridiculously long words would result, and thus it is not always practical, although very convenient in many cases.

The prefixes and terminations in general use are as follows:

PREFIXES.

Mono (Gr. *monos*, one). **Proto** (Gr. *protos*, first).

These are employed to designate a single atom or molecule of acid radical in combination with a base, or the *first* or lowest number of a series, when more than one proportionate combination is known. Before the names of radicals beginning with a vowel, the final *o* of these is generally omitted, for the sake of euphony.

Examples. — PbO, Lead monoxide. FeO, Iron monoxide, or protoxide. $FeCl_2$, iron protochloride (*not monochloride*).

Sesqui (Lat. *sesqui*, one and a half), meaning three atoms or molecules of acid radical to two of basic (since chemistry does not admit of splitting atoms), the ratio being one to one and a half.

Examples. — Fe_2O_3, Iron sesquioxide (Fe_2Cl_6 is sometimes called sesquichloride — the chloride of the sesquioxide). Al_2O_3, Aluminum sesquioxide.

Bi, or **Bin** (Lat. *Bis*, twice), **Di** (Gr. *dis*, twice), **Deuto** (Gr. *deuteros*, second), meaning two, or double, where two molecules of acid radical are combined, or twice as many molecules as there are of the basic radical. Di has also been used to refer to the basic radical in a similar way.

Examples. — HgI_2, Mercury biniodide, or deuto iodide. CS_2, Carbon disulphide ($Pb_2O(C_2H_3O_2)_2$ Lead diacetate).

Ter (Lat. *ter*, three). **Tri** (Gr. *tria*, three). Three atoms, or molecules of the basic radical.

Examples. — $AuCl_3$, Gold terchloride. Fe_2O_3, Iron trioxide. As_2O_3, Arsenic trioxide. $Fe_2(SO_4)_3$, Iron tersulphate.

Quadra (Lat. *quattuor*, or *quadras*, four). **Tetra** (Gr. *tetratos*, fourth), meaning four atoms, or molecules, of acid radical.

Examples. — $SnCl_4$, Tetra, or quadrachloride, of tin. $PtCl_4$, Tetrachloride of platinum.

Penta (Gr. *penta*, five). **Quinque** (Lat. *quinque*, five), meaning five.

Examples. — PCl_5, Phosphorus pentachloride.

Hexa (Gr. *hexa*, six). **Sex(t)** (Lat. *sex*, six), meaning six.

Examples. — SI_6, Sulphur hexaiodide.

Hepta (Gr. *hepta*, seven). **Sept** (Lat. *septa*, seven), meaning seven.

Examples. — Cl_2O_7, Chlorine heptoxide.

Poly (Gr. *pollos*, or *polu*, many), meaning many equivalents — usually when the exact formula is in doubt, as poly-iodides, many atoms (above three) of iodine combined with a base, etc.

Sub (Lat. *sub*, under). **Hypo** (Gr. *hupo*, under, or Lat. *hypo*, after). Sub refers to the base, and is used to designate salts which are composed of an oxide and another acid radical in varying proportions, or the so-called basic salts. Thus *sub*acetate of lead is a combination of lead oxide PbO and lead acetate $Pb(C_2H_3O_2)_2$. *Sub-*

sulphate of iron is an oxy- or basic sulphate, approximating $Fe_2O(SO_4)_2 + Fe_2(SO_4)_3 = Fe_4O(SO_4)_5$. Bismuth *sub*nitrate $BiONO_3$ (approximately). Most of these salts vary in composition, hence their formulas are not included in the Pharmacopœia.

The term *hypo* refers to the acid radical, and usually indicates the lowest of a series of oxyacid salts.

Examples. — $KClO$, Potassium hypochlorite.
KH_2PO_2, Potassium hypophosphite.

Per (Lat. *per*, above). **Hyper** (Gr. *hyper*, above). **Super** (Lat. *super*, above). The contracted form *per* is mostly used, and indicates the highest of a series of compounds, as contrasted with sub and hypo.

It is used mostly with oxy acids; when it refers to those containing the largest number of atoms of oxygen, the culmination of a series.

Examples. — $KClO_4$, Perchlorate of potassium. H_2O_2, Peroxide of hydrogen. Fe_2Cl_6, Perchloride of iron.

Ortho (Gr. *orthos*, straight). Used to distinguish substances in a normal condition from a modified form of the same, or from others which have been derived from them by heat or other causes.

Examples. — H_3PO_4, Orthophosphoric acid.

Pyro (Gr. *pur*, fire). Used to designate that the body has been produced by heat (fire). Thus $2H_3PO_4$, or $H_6P_2O_8$ + heat becomes $H_4P_2O_7$, *pyro*phosphoric acid, water (H_2O) being driven out.

$C_7H_6O_5$ gallic acid, heated becomes $C_6H_6O_3$ pyrogallic acid, CO_2 being driven out.

Meta (Gr. *meta*, beyond). Used to designate an altered condition, as distinguished from the ortho and pyro (and para) forms.

Thus, $H_4P_2O_7$ + heat becomes $2HPO_3$, metaphosphoric acid, water being driven out.

(The terms ortho, pyro and meta, as applied to *inorganic* compounds usually distinguish between forms produced by heat or similar causes.)

Para (Gr. *para*, from beside, near to, about, etc.). Used with *organic* compounds, when three bodies having the same chemical composition, but differing in physical properties (solubility, melting and boiling points, etc.) and certain chemical and medicinal properties, are to be distinguished. Such cases are differentiated by the terms ortho, meta and para.

Examples.—$C_6H_4(OH)_2$, Ortho-dihydroxy-benzol or pyrocatechin.
$C_6H_4(OH)_2$, Meta-dihydroxy-benzol or resorcin.
$C_6H_4(OH)_2$, Para-dihydroxy-benzol or hydrochinon.

Para also designates molecular aggregations of certain organic compounds, as C_2H_4O — aldehyde and $(C_2H_4O)_3$ or $C_6H_{12}O_3$ *par*aldehyde.

Hydro (Gr. *hudor*, water), used to designate the binary acids, *i. e.*, those composed of only two elements, the prefix referring then to the hydrogen, as HCl, hydrochloric acid, H_2S hydrosulphuric acid.

An (Lat. *an*, without). **De** (Lat. *de*, away from) meaning without or deprived of. Used to denote something which has been removed, therefore implying that the removed substance usually exists in the body normally.

Examples.—Anhydrous, without water (or moisture).
*De*odorized, deprived of color.

TERMINATIONS.

Ide, Id,[1] **Uret.**—Terminations used with salts composed of a base united to a *single element* or with *cyanogen*, as an acid radical, the latter being used mostly with sulphur, phosphorus and cyanogen.

Examples.—KI, Potassium iodid(e).
K_2S, Potassium sulphid(e), or sulphuret, sulfid.
KCN, Potassium cyanid(e), or cyanuret.
H_2S, Sulphuretted hydrogen, or hydrogen sulphid(e).
H_4P, Phosphuretted hydrogen.

Ous, Ite. — When a series of acids differ only in the proportion of oxygen which they contain, the lower members of the series end in *ous* and the salts of these in *ite*.

Ic, Ate. — The highest members of such a series of acids, or those which contain the most oxygen, end in *ic*, and the salts of these in *ate*.

Examples.—H_2SO_3, Sulphur*ous* acid, K_2SO_3 potassium sulph*ite*.
H_2SO_4, Sulphur*ic* acid, K_2SO_4 potassium sulph*ate*.

The following series well illustrates the use of some of these prefixes and terminations:

HCl, *Hydro*-chlor-*ic* acid. KCl, Potassium chlor*ide*, or hydrochlorate.

HClO, *Hypo*-chlor-*ous* acid. KClO, Potassium *hypo*-chlor-*ite*.

$HClO_2$, Chlor-*ous* acid. $KClO_2$, Potassium chlor-*ite*.

$HClO_3$, Chlor-*ic* acid. $KClO_3$, Potassium chlor-*ate*.

$HClO_4$, *Per*-chlor-*ic* acid. $KClO_4$, Potassium *per*-chlor-*ate*.

Oid (Gr. *eidos*, resemblance), used to express similarity in character and properties (not in composition).

Examples.—Alkaloid, resembles an alkali.
Crystalloid, resembles a crystal.
Resinoid, resembles a resin.

Ine, In.—In the Pharmacopœia these terminations are used to distinguish between alkaloids and other proximate principles. All alkaloids end in *ine;* Latin, *ina;* while glucosides, neutral principles, etc., end in *in;* Latin, *inum.*

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[1] The latest nomenclature prefers the termination *id*, and also substitutes *f* for *ph* in many cases, as sulfur, etc.

Examples.—Morphine. Latin Morphina.
Quinine. Latin Quinina.
Picrotoxin. Latin, Picrotoxinum.
Santonin. Latin, Santoninum.

CHAPTER IV.

MIXTURES.

Draught (Lat. *Haustus-us* or *Potus-us*), a mixture which is intended to be swallowed at a single dose. It usually measures from two to twelve fluidounces.

Drops (Lat. *Gutta-æ*), a term applied usually to stimulating or carminative mixtures, which are given in small doses and diluted when taken.

Linctus (Lat. *Linctus-i*), a thick and viscid liquid, composed of honey, syrup, etc., with medicinal matter, intended to be licked from a spoon. Also called a *lohoch*. It is adapted particularly for throat and bronchial tubes, coughs, etc.

Liniment (Lat. *Linimentum-i*), a liquid or very soft solid, usually of an oily or irritant character, used externally for the purpose of producing local action. They are applied mostly by rubbing, and when fluid are specifically called *embrocations* (Lat. *embrocatio-onis*); or they may be applied with a brush, and are then called *paints*. Lat. *Pigmentum-i*, also *Littus-oris*. In the latter case they are usually anodyne in action.

Lotion (Lat. *Lotio-onis*), an aqueous solution or mixture, for local application, usually without rubbing. They are usually aqueous fluids, are less powerful than liniments, and are applied in various ways. When used for specific purposes they have special names.

Injection (Lat. *Injectio-onis*), a lotion which is injected into the passages of the body by means of a syringe. When injected into the rectum it is called an *enema* (Lat. *enema-atis*), or *clyster*, and is used warm. Its purpose may be for producing evacuation of the bowels, for local medication, or (rarely) for general nutrition or medication. It is generally of a soapy or mucilaginous nature.

Hypodermic Injections. A clear, limpid solution, for injection beneath the skin, by means of a small needle-pointed syringe. These are used for producing immediate effects, by introducing the medicine directly into the blood.

Collunarium is a nostril injection.

Gargle (Lat. *Gargarisma-atis*) is a wash or lotion for the throat.

Collyrium (Lat. *Collyrium-i*) is a wash for the eyes; an eye-water.

Spray (Lat. *Nebula-æ*), a lotion or oily solution applied by means of an atomizer.

Inhalation, or Vapor (Lat. *Vapor-oris*), a fluid containing volatile medicines, which is either heated or added to boiling water, and the steam which arises is inhaled in order to obtain action on the throat or air-passages; or they are used in a special apparatus so arranged that air is drawn through the strong solution, and, becoming saturated with the medicines, in vapor, is drawn into the lungs through the mouth or nostrils.

Bath (Lat. *Balneum-ei*), a lotion or solution intended to be added to water for general application.

In general, *the term* "mixture" indicates all liquid preparations consisting of two or more simple bodies, or galenical preparations, intended for internal administration.

U. S. P. MIXTURES. — In the U. S. Pharmacopœia, the term "mixture" (Mistura, U. S. P.) is restricted to liquid preparations containing finely-divided solid matter in partial suspension. Thus, in the pharmacopœial sense a mixture is always a cloudy or muddy liquid, while in the general use of the term a mixture may be either clear or cloudy.

The art of preparing mixtures may in some cases be very simple, while in others it is very complex. The range of medicines which are prescribed in this form is very wide, embracing all chemical bodies, powdered drugs and galenical preparations.

But not only because the variety of mixtures which are called for is almost inexhaustible, but because these bodies are **brought together in the condition most conducive to changes,** is the art of combining bodies to form the best mixture, the most difficult to acquire. A prescription calling for the simplest form of mixture may be followed by one which requires much study and skill for its proper compounding.

Many bodies which may safely be combined in the solid form cannot be brought together in the presence of liquids without undergoing change.

Thus, subnitrate of bismuth and bicarbonate of sodium may be mixed and dispensed in powders without change, but when shaken with water they react slowly, and each is partially decomposed, carbonic acid gas being liberated and the stopper blown out by its pressure.

Chemical changes, then, may take place in mixtures which would not were the same bodies combined in a dry form.

A complete classification of mixtures is quite impossible, but a partial classification may be made, which will include the greater portion of these preparations.

SIMPLE SOLUTIONS.

✓ A solution has been defined as the blending together of the molecules of two bodies to form a clear liquid.

If we place *a lump* of sugar in water, it immediately begins to disappear, and after a few moments none of it can be seen, and the liquid will be perfectly clear. If we use the same amount of sugar *in a fine condition* (granulated), the disappearance is more rapid, and if the liquid be agitated it is still more so.

If we use hot water in place of cold, the sugar disappears almost immediately.

Thus, **solution is hastened** by having the solid in a fine condition, still more rapid if the liquid and solid be agitated together, and most rapid of all (with few exceptions) when the solvent is hot.

If, however, we drop sugar into chloroform or benzine, or many other liquids, it will not disappear, even if the liquid be warmed and agitated, but will remain in the condition in which it was placed in the liquid. Sugar therefore dissolves in water, but not in chloroform or benzine.

The solution which is formed will always measure more than the liquid which is used to make it, but not as much as the sum of its constituents; that is, not as much as the bulk of the original liquid plus the bulk of the original solid.

Thus, an ounce of sugar dissolved in an ounce of water will make more than a fluidounce of solution, but less than two fluidounces. For this reason, prescriptions often call for an amount of solvent or diluent sufficient to make the mixture measure up to a definite amount, the exact amount not being specified, because the room which the solids will occupy when dissolved cannot be calculated, but must be ascertained by experiment.

The same principle applies to two liquids as to a solid and a liquid.

If we add alcohol to water a clear homogeneous liquid results, which *measures less* than the sum of the quantities of each taken, showing that alcohol is soluble in water. If we use carbolic acid in place of the alcohol a portion of the acid will disappear or dissolve, but the remainder will separate and float upon the surface of the water.

If we heat the water and acid to about 200° F. (or 85° C.) they will then mix to form a clear homogeneous liquid in all proportions, showing that carbolic acid is only partially soluble in cold water, but freely soluble in hot water. Again, if we shake together chloroform and water, or some oil and water, each mixture will separate into layers showing no apparent change in the volume of either liquid, because oil and chloroform are practically insoluble in water or water in them.

Again, if we rub together camphor and chloral, or camphor and thymol, a clear liquid results, which is probably a solution of one solid in the other.

In the case of two liquids or two solids either body may be considered the solvent, as when ether and water are shaken together the water dissolves 10 per cent. of ether and the ether dissolves 3 per cent. of water. In the case of a liquid and a solid the liquid is considered the solvent and the solid the body dissolved.

All bodies, whether solid, liquid, or gaseous, can be dissolved in *some* liquid, but none are soluble in *all* liquids. Some are capable of forming very strong solutions and in a brief time, while others dissolve slowly and only in small proportions.

In some cases a body which is only slightly soluble is yet quickly soluble, as cream of tartar. In all cases the rapidity with which the solution is formed as well as the amount of body dissolved is dependent upon the temperature. When all of a body is dissolved that is capable of dissolving at that temperature the solution is called *saturated*, but a solution which is saturated at one temperature will be either supersaturated or subsaturated at all other temperatures.

In pharmacy the temperature which has been adopted for saturated solutions is 15° C. (59.6° F.), because the temperature of living-rooms where solutions are supposed to be kept or used is rarely below this point, and at all higher temperatures the solutions (with a few exceptions) will be subsaturated.

When no other liquid is designated for a solution, water is understood. Besides this, other important solvents are alcohol, mixtures of alcohol and water, glycerin, oils, ether, chloroform, benzine, etc.

The solubility of each body in the different liquids can be learned be reference to each in the text or reference books.

There is no general rule for solubility, but in case a body is in question the chemical nature of which is understood, but no reference to its solubility in any given liquid can be found, a judgment as to the probability of such a solution can be made according to the law given by Prof. Ostwald, viz.:—that "solubility is determined to some extent by the *chemical analogies* both of the substance dissolved and the solvent." Thus, almost all alcohols are soluble in common alcohol, and all organic acids in acetic acid. The alcohols and organic acids all contain the group (HO) in their formulas, and are generally soluble in water (H_2O), the solubility decreasing as the proportions of carbon in the compounds increase. Thus we have benzol, C_6H_6, insoluble in water, but carbolic acid, C_6H_5HO, is soluble to the extent of 5 per cent. (cold), hydrochinon, $C_6H_4 2(HO)$, is much more soluble, while pyrogallic acid, $C_6H_3 3(HO)$, is very soluble.

Here the larger the proportion of the radical HO the more freely will the body dissolve in water (H_2O), while similar compounds which contain no HO are insoluble.

Nearly all mixtures contain a solution or a mixture of solutions, and thus these occupy a very important position in dispensing. Many liquids dispensed as a mixture consist of a solution of a salt in an aqueous fluid, either alone or mixed with other fluids or flavoring.

When the salt is very soluble and the solution will not be concentrated, the solvent may be placed in the bottle and the solid dropped into it.

A little shaking usually effects solution, and the other ingredients, if any, are then added.

If the salt is slowly soluble, or the solution is to be very strong, the salt should be triturated in a mortar with successive portions of the solvent until it is all dissolved, or hot water should be used.

Gums and colloidal bodies are best dissolved, after breaking into very small pieces, by circulatory displacement. In all cases the solids should be added to the liquid, not *vice versa.*

When two or more liquids of different character are prescribed with a solid, the solid should first be dissolved in the liquid which is the best solvent for it, then this solution mixed with the other liquids. In this way a clear or homogeneous mixture is most quickly obtained.

Solids will dissolve more readily when in a granular or powdered form. The granular form is to be preferred in many cases, because salts are generally more uniform in the crystalline than in the powdered condition, particularly such as contain water of crystallization. The powders are more liable to lose some of the water, and so are less soluble.

An exception to the powdered condition is found in the scale-salts of iron (citrate, soluble phosphate, etc.), which "gum up" if triturated with water, and are most readily dissolved by shaking with warm (not too hot) water.

A mixture should never be allowed to leave the dispending counter with undissolved crystals in the bottle.

Heating a solvent to facilitate solution is not always desirable, because (1) the solvent may be injured, as in the case of the aromatic waters or hydroalcoholic liquids; or (2) the subsequent admixture of an alcoholic or aromatic body to the hot liquid may volatilize some of these ingredients; or (3) a supersaturated solution may be unwittingly prepared, which will afterward recrystallize; (4) or the salt may be partially decomposed, as in the case of chloral, bicarbonates, etc.

The dispenser must aim, not only to get a solid in solution, but also to keep it dissolved. This, of course, cannot always be accomplished where a physical or chemical incompatibility afterward ensues.

Mixtures of liquids which form a clear liquid, may be considered as solutions of one liquid in another. Even where the fluids will form a clear mixture in any order of mixing, a definite order may be desirable.

When powerful liquids in small quantities are prescribed in a mixture, such as hydrocyanic acid, solutions of arsenic, strychnine, morphine, etc., a portion of the other ingredients should be first placed in the bottle, then the powerful ingredients carefully measured, added, and the graduate rinsed with the remaining ingredient of the mixture.

In the same way, when a viscid liquid is to be mixed with a limpid one, the graduate in which the viscid liquid has been measured should be rinsed with the limpid liquid.

In case of an incompatibility, however, these considerations are of minor importance compared with that of avoiding precipitation, or change in the mixture, as much as possible.

It is very convenient, when certain salts are being frequently called for in mixtures, to keep on hand a concentrated solution of these salts. Thus strong solutions of potassium acetate, or iodide, adjusted so that one fluidrachm of the mixture will contain 15 or 30 grains of the salt, may save time in dispensing solutions.

In a few stores **potassium acetate** is never purchased, but a solution of the above strength made when needed by treating potassium bicarbonate with acetic acid; thus 3920 grains (8 troy ounces and

80 grains) of potassium bicarbonate dropped slowly into 12 fluidounces of acetic acid (36 per cent.), and when effervescence has ceased, enough more acetic acid is added to render the liquid neutral, and then the whole carefully diluted with water to measure just one pint; one fluidounce of this solution will contain four drachms (240 grains) of potassium acetate. Where solutions of this kind are used they should be carefully measured, both when making and dispensing them, since an error in quantity is much more easily made in measure than in weight. Solutions of salts which are disagreeable to handle, as ammonium valerianate, or of salts which dissolve very slowly, as mercuric chloride (also used in very small weights), are convenient for stock-solution.

Stock-solutions are easily made by circulatory displacement. A conical percolator is tightly stoppered and filled with the solvent, then the salt is tied in a piece of thin cloth and suspended just beneath the surface of the liquid, and the percolator covered. Solution begins immediately and continues until the liquid is saturated or the salt entirely dissolved. A wide-mouth bottle may be substituted for the percolator if desired.

Where an air-blast can be used, a quick and convenient method of making large quantities of solutions is to place the salt and solvent in a bottle or jar and blow air through the liquid which agitates both the salt and the solvent and the former quickly passes into solution. If an aspirator is at hand the same result may be obtained by passing a tube through the stopper of the bottle to near the bottom, then the air is sucked through this tube and the liquid by means of a second tube which passes through the stopper, but does not touch the liquid, the other end of this being connected with the aspirator. A bit of cotton should be placed in the end of the air-tube to filter the air ere it enters the liquid. If the water has also previously been sterilized by boiling, the solution will be less liable to change or to develop fungous growths.

Among the salts suitable for stock solutions are ammonium chloride (1 in 4), magnesium sulphate (1 in 2) sodium sulphate (1 in 4), potassium bromide (1 in 2), potassium acetate (1 in 2).

Iodides, tartrates and alkaloids (salts of) are not suitable for stock-solutions unless used up promptly, because the salts quickly decompose when in solution. Most organic bodies are subject to change in this condition and thus the stock-solutions are restricted properly to solutions of metallic nitrates, sulphates, chlorides, and bromides.

Even these solutions will keep better if filtered when first made, for no matter how clear they may look at first, filtration will usually brighten their appearance, and also remove any minute particles which may encourage crystallization.

Petroleum solutions, used as sprays, have come into use in recent years. These are usually solutions of volatile oils, camphoraceous bodies (thymol, menthol, camphor, etc.) and other antiseptics in liquid petrolatum. When the bodies directed are soluble in the liquid petrolatum, these are made in the same way as aqueous solutions, but without heat. Unfortunately, however, liquid petrolatum is very limited in its solvent powers, and substances are frequently ordered which will not dissolve in the oil. In many cases, these are soluble in almond or olive oil, and a clear solution can be made by dissolving first in one of these oils and mixing this solution with liquid petrolatum. In this way a clear, oily solution can be dispensed, which is suitable for use in an atomizer. When substances are ordered which are not soluble in oils, there is no way of securing a preparation suitable for use in an atomizer.

COMPOUND SOLUTIONS.

In some cases salts which are but slightly soluble, or very slowly soluble, in water, are freely soluble in a solution of another salt.

Quinine sulphate is but slightly soluble in water, but dissolves freely if a little acid be added to the water, being changed into an acid salt; the bisulphate, for instance, when sulphuric acid is used.

Whenever salts are thus dissolved by aid of another salt, a chemical change takes place, commonly a double salt being formed; but in most cases without change of medicinal properties.

These solutions are often more stable than a solution of the principal salt, as well as being stronger; as in the case of corrosive sublimate dissolved in ammonium chloride solution. The ordinary solution of corrosive sublimate in water is gradually decomposed. But one containing ammonium and sodium chlorides is not only more easily prepared, but is also permanent.

The following formula for a solution of corrosive sublimate (1 to 1000) for antiseptic purposes has recently been recommended, making a solution which will keep indefinitely; corrosive sublimate, 1 Gm.; ammonium chloride, 20 Gm.; sodium chloride, 10 Gm.; distilled water, 1000 Cc.

A knowledge of the best solvent for each salt or chemical is often useful to the pharmacist in manufacturing or dispensing, and may often rectify a faulty prescription. Many physicians depend upon the pharmacist to make such additions to their prescriptions as shall make them more elegant in appearance or taste, yet not alter their medicinal properties.

Thus iodine is sometimes directed in aqueous solution, and the pharmacist expected to add a sufficient quantity of potassium iodide to effect solution. Sometimes the addition of a solvent becomes a necessity; as where red iodide of mercury is prescribed in an aqueous mixture. This is insoluble in water, and is a powerful poison, safely taken only in very small doses.

To suspend it in a mixture would not be safe, because it settles very quickly; but the addition of a little potassium iodide will dissolve it, and this solution will remain evenly diffused throughout the mixture, rendering it safe as well as more elegant.

Glycerin has valuable solvent properties in many cases, and being without any decided therapeutic action the pharmacist is usually justified in using it to improve prescriptions. It is particularly valuable in solutions containing tannin, being used in many official tinctures and fluid extracts for this purpose, as well as for a partial substitute for alcohol, which it resembles in solvent properties.

It dissolves most deliquescent salts, some metallic nitrates, chlorides and sulphates, many organic acids (as tannic and gallic acids, etc.), and several metallic oxides, notably oxide of lead (litharge), which it dissolves in large quantities. It is owing to this that a mixture of glycerin and litharge makes a tenacious cement for joining porcelain, glass or wedgewood-ware, for filling the handles of pestles, etc. A high temperature greatly increases the solvent power of glycerin.

Sodium citrate, the neutral tartrates, and ammonium chloride possess remarkable solvent powers over many metallic salts. Sodium citrate entirely prevents the precipitation of iron salts in neutral solutions, and alkaline tartrates (as Rochelle salt, potassium tartrates), dissolve iron and copper hydroxides, the insoluble salts of zinc, manganese, nickel, cobalt, chromium, and aluminum; while a boiling solution dissolves barium, strontium, magnesium, and calcium salts, also.

Advantage may be taken of these salts in preventing precipitation, when a smaller quantity will suffice than would be needed to dissolve a salt already precipitated.

The quantity of solvent salt necessary to use in various cases depends, not only upon the character of the salts involved, but often upon the strength of solution desired. For instance, one part of potassium iodide, dissolved in two parts of water, will dissolve two parts of iodine: but if this solution be diluted with water, a portion of the iodine will be precipitated, and a further addition of potassium iodide becomes necessary.

The value of salt-solutions as solvents is recognized in the Pharmacopœia in the scale-salts of iron, in Fowler's, Valangin's, Goulard's, and Lugol's solutions, in syrup of lime, and many others.

The following list and table offers many hints for cleansing chemical and pharmaceutical apparatus, for making solutions for use in the arts and for general prescription-knowledge.

The insoluble salts of **Benzoic Acid** are readily soluble in aqueous solutions of sodium acetate, lead acetate, or sodium nitrate; potassium nitrate, however, will not dissolve them.

Borates are more soluble in solutions of boric acid.

Carbonates are all soluble in solutions of carbonic acid, pressure being sometimes necessary in order to obtain a sufficient quantity of the gas in solution.

The carbonates are by this means converted into bicarbonates, hence it may be said that all bicarbonates are soluble.

Citrates are, many of them, soluble in solutions of sodium, potassium or ammonium citrate.

Ferricyanides and **Ferrocyanides** are soluble in caustic alkalies, both fixed and volatile.

Lactates are much more readily dissolved by boiling than by cold water.

Oleates are soluble in kerosene oil, oil of turpentine and ether.

Phosphates are soluble in phosphoric acid and alkaline phosphates, and

Pyrophosphates are soluble in alkaline pyrophosphates.

Tartrates are soluble in tartaric acid and caustic alkalies.

TABLE OF COMPOUND SOLVENTS.

Bodies slightly soluble in water, but more soluble in non-alcoholic solutions of other bodies.

SALT.	SOLVENT (Salt in Aqueous Solution).
Acid Arsenous	Weak Acids and Alkalies, Glycerin.
" Benzoic	Sodium Benzoate, Sodium Phosphate, Sodium Sulphate.
" Boric	Borax, Glycerin, Syrup.
" Carbolic	Hot Water, Glycerin, Oils and Solutions of Soap, Sodium, Acetate, and Valerianate, Ammonium Benzoate, Salicylate, etc.
" Gallic	Potassium Citrate.
" Salicylic	Borax and Soluble Acetates, Citrates and Phosphates.
Barium Sulphate	Ammonium Nitrate, Alkaline Citrates.
Bismuth Citrate	Ammonia Water.
" Subcarbonate	Ammonium Carbonate.
" Subgallate	Caustic Alkali Solutions.
Borax	Sugar (increases the solubility).
Bromine	Hydrobromic Acid, Potassium Bromide, etc.
Caffeine	Organic Acids, Sodium Benzoate and Salicylate.
Calcium Carbonate	Carbonic Acid Water, Ammonium Chloride.
" Hydroxide	Sugar.
" Phosphate	Acids, Ammonium Chloride.
" Sulphate	Nitric and Hydrochloric Acids, Potassium Nitrate, Sodium Thiosulphate, Ammonium Salts.
Cerium Oxalate	Ammonium Chloride.
Chrysarobin	Alkalies.
Cotton	Ammonio-sulphate of Copper.
Iodine	Potassium Iodide, other Soluble Iodides, Tannic Acid.
Iodoform	Fixed and Volatile Oils.
Iron Subcarbonate	Carbonic Acid Water, Sugar.
" Ferrocyanide	Oxalic Acid, Alkalies.
" Oxalate	Oxalic Acid and other acids.
" Oxide and Hydroxide.	Sugar and Citrates.
" Phosphate	Alkaline Citrates and Tartrates.
" Pyrophosphate	
" Tartrate	
Lead Iodide	Ammonium Chloride, Potassium Iodide and Acetate, Sodium Thiosulphate, Alkali Solutions.
" Oxide	Lead and Alkaline Acetates.
" Sulphate	Ammonium Acetate.
Lithium Benzoate	Sodium Benzoate.
" Carbonate	Carbonic Acid Water.
Magnesium Carbonate	Carbonic Acid Water.
" Phosphate	Inorganic Acids.
Mercury Benzoate	Sodium Chloride, Ammonium Chloride.
" Bichloride	Ammonium Chloride, Sodium Chloride.
" Biniodide	Potassium Iodide, Mercury Bichloride, Sodium Thiosulphate.
" Sulphate	Potassium Sulphate.
" Ammoniated	Ammonium Acetate, Carbonate or Nitrate.
Pepsin	Hydrochloric Acid.
Potassium Bitartrate	Borax and Alkalies.
Quinine Sulphate*	Weak Acids, Tinct. Chloride Iron, Huxham's Tincture.
Saccharin	Alkalies.
Salophen	Caustic Alkali.
Silver Cyanide	Potassium Cyanide, Sodium Thiosulphate, Ammonia.
" Iodide	Potassium Cyanide, Alkaline Iodides.
Tragacanth (Bassorin)	Hydrogen Peroxide.
Zinc Carbonate	Ammonia Water.
" Oxide	Ammonium Carbonate.

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* When quinine sulphate is ordered in solution, no acid or other solvent being designated, weak sulphuric acid should be used on account of the resulting fluorescence which is not present in other acid solutions.

Solutions of tar oil in soap—the soap being largely in excess—will give a clear solution with water in all proportions, while solutions of soap in tar oil, the oil being in excess, form emulsions with water. Pure carbolic acid at 20° is miscible in any proportion with a saturated (at 15°) solution of sodium acetate, or with a 50 per cent. solution of sodium valerianate. Solutions of phenol in the latter can afterward be diluted with water without becoming cloudy or opaque. Sodium valerianate solution also dissolves cresol in all proportions. Rosin soap also possesses the property of dissolving large quantities of phenol, while cresol dissolves readily in a 15 per cent. solution of oleic soap, one part of the latter being capable of rendering soluble in water five times the amount of cresol. This fact explains the possibility of preparing soluble mixtures containing 50 per cent. of cresol. The salicylates, benzoates, etc., of ammonia also dissolve phenol and cresol, but not to the extent of soap solutions. Solutions of phenol in soap also have the property of dissolving benzine, toluene, oil of turpentine, etc.

Oil solutions, used as sprays, have become popular of late in the treatment of throat and nose diseases. Liquid petrolatum is the usual vehicle for these, and its solvent powers are more limited than the vegetable oils. Most oil-soluble substances are more soluble in olive or expressed almond oil than in petroleum oils, and some, as resorcin, aristol, iodoform, etc., are soluble in the former, but not in the latter. Since sprays must be clear and perfect solutions, the use of a vegetable oil in place of a portion of the petroleum oil is often necessary. For instance, when resorcin is directed in these oil solutions, the only method by which a clear oil solution can be obtained is to dissolve the resorcin in as little olive or almond oil as possible and mix this with the liquid petrolatum. Menthol, thymol, etc., which are soluble in the liquid petrolatum, need no special consideration. If alkaloids are directed in such solutions, the free alkaloid must be used, not the salt. Some of the free alkaloids, as cocaine, are soluble in the liquid petrolatum. Those that are not must first be dissolved in a little oleic acid, and this in turn in the petroleum oil.

PERCENTAGE SOLUTIONS.

Percentage solutions or solutions containing a required percentage of active ingredients are sometimes ordered by the physician. Since percentage means the number of parts in a hundred, the only difficulty in this class of preparations should be in allowing for the contraction in making the solution.

Thus **a 4 per cent. solution** of cocaine hydrochlorate would mean, technically, a solution containing four parts of the cocaine in every hundred parts of solution, and to make an ounce of such solution we first calculate the amount of cocaine to use, viz.: 4 per cent. of 456 grains (the weight of a fluidounce of water), or 18¼ grains, and dissolve this amount in 438 grains (*not* one fluidounce) of water.

This will give *slightly less than a fluidounce* of solution, but the deficiency in a solution as weak as this will be scarcely observable.

If however a strong solution be desired as a 25 per cent. solution of a salt, then a larger quantity must be calculated for, because if we take 25 per cent. of 456, which is 114, and use only 342 grains of water (456 — 114 = 342) to dissolve this amount, we shall fall considerably short of the required amount, though we should make a 25 per cent. solution.

The exact amount by weight which we should have to make in order to get a fluidounce, could only be ascertained by knowing the specific gravity of such a solution and multiplying the weight of an equal volume of water by this specific gravity in order to get the weight of the required volume of solution.

This is scarcely necessary in practice, since a little judgment will enable one to choose the nearest *round number* which is likely to yield the full volume of solution. The nearest round number to 456 is 500, and calculating 500 grains to the fluidounce we would require 125 grains of the salt and 375 grains of water, still too small a quantity of water. The next round number is 600 and 25 per cent. of this is 150, leaving 450 grains of water in which to dissolve it, or almost exactly a fluidounce of water, and we may expect with these quantities (viz: 150 grains of salt and 450 grains of water) a *little more* than a fluidounce of solution, since the salt will increase the bulk somewhat when dissolved.

The excess of bulk may be dispensed (as percentage solutions are almost always prescribed alone) or thrown away as may seem best. **If another solvent than water be used,** we must also make a correction for the specific gravity of the liquid and first calculate the weight of the required volume of that liquid.

Thus if either be used (sp. gr. 0.75), we find that a fluidounce of it will weigh 456 × 0.75 = 372 grs., if glycerin (sp. gr. 1.25), a fluidounce will weigh 456 × 1.25 = 579 grains, or if chloroform (sp. gr. 1.50), a fluidounce will weigh 356 × 1.50 = 683 grains.

Then these products (or their near round numbers if a strong solution is to be made) are to be taken as the basis of calculation.

Unfortunately, however, **percentage solutions are not always made by weight.** It is much easier for the physician in certain cases to calculate the dose if in making the solution the *solids are weighed and liquids are measured.*

In the case of aqueous solutions this makes little difference, being only a little less accurate, but with other solvents it alters the proportions of solid solvent very appreciably.

Thus a 10 per cent. solution of iodoform in ether would, in the first case, contain 10 grams of iodoform in 100 *grams* of solution —

about 125 cubic centimeters — while in the second case it would contain 10 grams in 100 *cubic centimeters* of solution (about 70 grams), the second method (weighing the solid and measuring the liquid) making a much stronger solution than the first.

On the other hand, if chloroform be used as a solvent, the solution would be weaker; if the chloroform be measured for making it by weight we would have 10 grams in 100 grams, about 63 *cubic centimeters*, while in the second case it would contain 10 grams in 100 cubic centimeters.

Since the physician measures all liquids in dosing, a teaspoonful of solution will contain the same weight of solid whichever solvent is used (the solid being weighed and the liquid measured in making the solution), the bulk being the same in all cases, though the weight and percentage strength varies.

Again, by this rule, strong solutions are stated as much stronger than they really are. For instance, if we dissolve a Troy ounce of potassium iodide in 5 ½ fluidrachms of water, we shall have just a fluidounce of solution, of which one minim would contain one grain of the iodide, — apparently a 100 per cent. solution, though such a thing is really impossible.

It is thus sometimes uncertain just what a physician wishes when he orders a percentage solution.

The object of the dispenser should always be to supply what the physician desires, but physicians differ in their objects in writing for percentage solutions, sometimes desiring them to be made by weight and sometimes by volume, and it is not always possible to tell from the reading of the prescription which the physician desires. This lack of uniformity is shown in the fact that in the two leading hospitals in Boston, each having a large corps of physicians, one corps desires all percentage solutions to be made by weight and the other by weighing the solid and measuring the liquid.

Professor Oldberg gives a simple formula for making percentage solutions by weight while measuring the water. Let a represent the number of grains of solvent, and b the percentage strength of the solution to be made. Then

$$\frac{a \times b}{100 - b} = c.$$

c represents the number of grains of salt required to add to a. For instance, to make an ounce of a 5 per cent. solution

$$\frac{455.19 \times 5}{100 - 5} = 23.957 \text{ grs.}$$

Then dissolve 24 grains of the substance in a fluidounce of water to obtain a 5 per cent. solution.

On the basis of the above, Mr. H. C. Landenbeck has worked out the following table:

4.597	grs. in	1	fluidounce	= 1 per cent.	0.456	grs. in	1	fluidounce	= 1 in 1000.
9.289	“	1	“	= 2 “	0.912	“	1	“	= 1 in 500.
14.078	“	1	“	= 3 “	1.141	“	1	“	= 1 in 400.
18.966	“	1	“	= 4 “	1.522	“	1	“	= 1 in 300.
23.957	“	1	“	= 5 “	2.290	“	1	“	= 1 in 200.
50.576	“	1	“	= 10 “	4.597	“	1	“	= 1 in 100.
80.327	“	1	“	= 15 “	9.289	“	1	“	= 1 in 50.
113.797	“	1	“	= 20 “	18.966	“	1	“	= 1 in 25.
151.730	“	1	“	= 25 “	50.576	“	1	“	= 1 in 20.
303.460	“	1	“	= 40 “	113.797	“	1	“	= 1 in 5.

GASEOUS SOLUTIONS.

Nearly all gases are soluble in water to a considerable extent, nitrogen being an exception — almost insoluble in water, though some of the compounds of nitrogen, as ammonia gas, NH_3, are freely soluble.

Cold water dissolves much more gas than warm, and the amount of gas which will remain in solution is directly proportionate to the pressure. Thus one volume of water will dissolve an equal volume of carbonic acid gas under normal conditions, but if the pressure is doubled the same amount of water will dissolve two volumes of gas.

Solution of gases under pressure are not often prepared by the pharmacist, since they require special apparatus (with a few exceptions). Familiar examples of such solutions are the aerated table- and mineral-waters usually sold in bottles, and the "soda water" which is stored under pressure in metallic tanks and drawn from the "fountains" as required for immediate consumption.

All of these solutions effervesce as soon as the pressure is withdrawn, and a portion of the gas escapes.

Solutions of gas under normal pressure are often prescribed, and *should be always freshly prepared.*

In writing for these the physician usually prescribes an acid and a carbonate or bicarbonate in the same mixture and leaves it to the intelligence of the dispenser to know that the bicarbonate will be decomposed and to furnish a solution of the gas.

These solutions will always be acid to litmus paper unless an excess of the carbonate is used, because the gas is acid. They are best made in a bottle, and should never be filtered or strained. If a bright and clear solution is desired, the acid and alkaline [or saline] solutions may each be filtered before mixing, but never after the gas has been liberated. If the solution is to contain other volatile or viscid ingredients (syrups, mucilage, etc.), these should be added last, since the former will be partially lost in the effervescence, and the latter retards the escape of gas so much that the effervescence becomes tedious, or else takes place spasmodically and is liable to spurt out some of the liquid. When the quantities of acid or salt are left to the judgment of the dispenser, reference is had to the saturation tables in the back part of the Pharmacopœia.

The use of carbonic acid gas as an adjuvant to saline solutions is steadily increasing. Its value lies partly in its cooling and mildly stimulating action upon the stomach and fauces, and also in its efficiency in correcting or disguising the taste of salts, or in preventing oxidation of some easily-changed bodies.

Mixtures may contain it in solution under normal or increased pressure, in the latter case more of the gas being retained in solution.

These pressure solutions, of which effervescing solution of magnesium citrate, U. S. P., is a type, are always contained in stout, round bottles which should not be too full.

Flat-sided bottles, even when made of heavy glass, are liable to burst under the pressure, hence even the bottoms of bottles intended for this use are rounded to make them more resistant to the pressure.

A little air space in the bottle also allows for a slight increase or decrease of pressure caused by varying temperatures, with less risk of an explosion.

In making these solutions the carbonate or bicarbonate is added last, either in crystals which are not allowed to dissolve before inserting and tying in the stopper, or in a solution which is poured slowly down the side of the bottle so as to form a separate layer of liquid, as recommended by Professor E. L. Patch. In the latter case more time is allowed for inserting the stopper and less gas is lost.

Bottles containing effervescent liquids are best kept stored upon their sides, in order to keep the cork wetted and swollen, and prevent the gradual escape of gas.

Solutions containing the gas under normal pressure should be so made as to retain as much of the gas as possible. To this end the water should be *cold* (because cold water dissolves more gas than warm water), and the effervescence should take place in presence of *all* the liquid, the mixture then being bottled as soon as effervescence has ceased. Under these circumstances the liquid will dissolve about its own bulk of carbonic acid. No special bottles are required for these mixtures.

Prescriptions calling for salicylic acid, sodium bicarbonate and water are a very common type of this class. When made they are essentially a solution of sodium salicylate, saturated (under normal pressure) with carbonic acid gas, the latter being the object sought by the physician as well as the former.

Chlorine solutions obtained by the action of hydrochloric acid upon a chlorate are often prescribed for affections of the throat.

In ordering a mixture containing these two bodies, the physician may wish either an acidulated solution of potassium chlorate, in which chlorine gas is liberated very slowly, or he may wish a solution containing the full amount of chlorine in solution.

In the first case, the chlorate is first dissolved in the water, and the acid added last, while in the second case the dry chlorate is covered with the strong acid and the reaction allowed to proceed until the bottle is filled with the chlorine fumes, the water being then added in portions, so as to check the reaction as little as possible, yet dissolve the gas ere it escapes from the bottle.

When a solution of the gas is desired the method directed by the Pharmacopœia (1900) for compound chlorin water is the best.

Mixtures which by reaction give off nitric oxide gas (NO) are sometimes met with. These differ from the other gaseous reactions in that the *nitric oxide should not be retained* in the solution. The gas is liberated from nitrates or nitrites and is not only irritating, but is an active chemical agent, and may cause further change in other ingredients.

Thus, in mixtures containing spirit of nitrous ether, an acid or acid salt, and potassium or sodium iodide, there will be a reaction between the acid, nitrous ether and the iodide, free iodine and nitric oxide being liberated.

$$\begin{array}{ccccccccccccc} C_2H_5NO_2 & + & KI & + & KHC_4H_4O_6 & = & C_2H_5OH & + & K_2C_4H_4O_6 & + & I & + & NO \\ \text{Nitrous ether.} & + & \text{Pot. iodid.} & + & \text{Pot. bitart.} & = & \text{Alcohol.} & + & \text{Potass. Tart.} & + & \text{Iodine.} & + & \text{Nitric Oxide} \end{array}$$

And if there be an excess of iodide present, the nitric oxide, in presence of air, will decompose this also and liberate all the iodine, hence the reaction should be allowed to take place in an open, and preferably shallow vessel, in the presence of as little liquid as possible, so that the gas may all pass off into the air.

In all cases where a nitrate or nitrite is decomposed and liberates nitric oxide, this method of procedure should be resorted to, since a solution of the gas is never desirable for medicinal purposes.

Where the other ingredients are not injured thereby, a little heat may be resorted to, in order to remove the last portions of the gas.

MIXTURES CONTAINING INSOLUBLE BODIES.

These are of two classes: Those in which an insoluble powder is *added to* the liquid, and those in which the insoluble body is *formed in* the liquid by the interaction of two of the ingredients.

In the first case, the mixture, of course, should never be filtered; in the latter case it is often a question whether filtration is proper or not. When in doubt, DON'T.

Mixtures of the first class are usually made by triturating the dry powder with a small portion of liquid, until a smooth paste is obtained; then this may be transferred to the bottle, and the mortar rinsed with fresh portions of liquid; or the liquid may all be mixed in the mortar, and afterward transferred to a bottle.

In some cases — where the powder is somewhat soluble in the liquid, as in case of quinine sulphate, cream of tartar, magnesium carbonate, etc. — the powder may be evenly diffused by adding to the liquid in the bottle and shaking vigorously, but in most cases trituration in a mortar is necessary to prevent lumping.

If a powdered drug, as rhubarb, for instance, be added to a liquid in a bottle, the oily surface of the powder will prevent the liquid from wetting it evenly, and lumps will form, which cannot be broken by agitation, nor be easily brought under the pestle in the presence of a large proportion of liquid, if afterward transferred to a mortar. A proper start in mixtures of this sort often saves much time.

Very light powders, as powdered charcoal, vegetable drugs, salol, etc., are difficult to incorporate with liquids because of their tendency to fly out of the mortar. A small amount of liquid added to these requires much trituration to uniformly moisten the powder, during which the powder flies persistently out. If too much liquid be added, the powder floats upon its surface, and cannot easily be wetted. Such powders are best treated by first making into a soft cream with glycerin or syrup, with which they can easily be incorporated, this cream being afterward triturated with the diluent, and a homogeneous mixture thus obtained. Mucilage of acacia is even better for salol and water-repellent substances.

Many salts (such as subnitrate of bismuth, phosphate of calcium, magnesium hydrate, etc.) **are somewhat gelatinous when freshly precipitated,** but become hard and granular, or heavy, when dried. These freshly-precipitated salts are of special advantage in mixtures of this class, because they do not settle as quickly. These are beyond the range of ordinary single prescription dispensing, but can be prepared in quantities to advantage.

The "Milk of Magnesia" is a familiar example of these, made by precipitating a solution of magnesium sulphate with sodium or potassium hydrate, washing this precipitate by decantation until free from sulphate, then suspending in water. It corresponds essentially to calcined magnesia, but remains suspended in the water for a long time. The Ferri Oxidum Hydratum cum Magnesia of the Pharmacopœia (arsenical antidote) is another illustration of these, and also of the special therapeutic value of such mixtures. A dried ferric hydroxide would not be effective as an antidote to arsenic.

Another advantage in a suspended body is that its taste is not as pronounced as when it is in solution. This is the case with quinine sulphate; when it is suspended in a liquid its bitterness is not very objectionable, but if it be dissolved by an acid, the bitterness is very pronounced. For this reason, *quinine should not be dissolved by addition of an acid unless ordered by the physician.*

MIXTURES CONTAINING CHEMICALLY INCOMPATIBLE BODIES.

The greater diffusibility of undried or freshly-precipitated salts often leads the physician to prescribe in such a way that the insoluble body will be *formed in compounding the prescription* by the admixture of solutions of two incompatible salts or other bodies.

These mixtures are based on the general **law of incompatibility,** viz.: when two salts can, by interchange of their radicals, form an insoluble salt, the insoluble salt will be formed and precipitated.

Such mixtures, containing an intentional incompatibility should of course, never be filtered, but dispensed with a shake-label.

In all mixtures which are liable to form an insoluble body by reaction, **the first effort of the dispenser should be to avoid this formation if possible.** This may often be done by diluting the antagonistic bodies before mixing, or by the intervention of some viscid body, as syrup or glycerin, which may retard if not entirely prevent the reaction. The body which is liable to be precipitated should be treated much as a General prepares a weak force to meet the attack of a strong one, — viz.: the weak force is first protected by fortifications and placed in such a position as to receive the attacking party in sections and not all at once.

The following prescription — a striking example of incompatibility overcome by skill in mixing — will serve to illustrate this:

℞.	Tinct. ferri chloridi	ʒii.
	Spiritus ætheris nitrosi	ʒiv.
	Mucilaginis acaciæ	℥i.
	Syrupi	ʒx.—Mix.

Mucilage of acacia is incompatible with both of the first two ingredients, forming a gelatinous semi-solid with chloride of iron, and being precipitated in a ropy rubber-like condition by alcohol in both. This, then, being the ingredient to be protected, if we first fortify the mucilage with the syrup, then add the other ingredients a few drops at a time, shaking thoroughly after each addition and giving time for the mucilage to overcome the attack before more is added. The result will be a bright, clear, ruby-red liquid.

When the reaction cannot be prevented by skill in mixing, or be materially retarded by the intervention of a viscid liquid, the mixture should be compounded with the intention of obtaining the precipitate in as fine a condition as possible, so that it will diffuse evenly through the mixture on shaking.

The incompatible bodies should be mixed in dilute solutions, and well shaken together.

Oftentimes the pharmacist is justified in either leaving out an incompatible ingredient, *when it has no decided medicinal value in the mixture*, but has been ordered simply as a solvent or adjuvant, or in adding a simple solvent, as alcohol or glycerin, to a mixture in order to hold in solution a body which would be precipitated in an aqueous liquid.

The two following mixtures will illustrate this:

℞.	Quininæ sulphatis	ʒii.
	Acidi sulphurici diluti	ʒi.
	Ext. glycyrrhizæ fluid	℥ss.
	Syrupi	℥i.
	Aquæ destillatæ	q. s. ut ft., ℥iv.—M.

Here the diluted sulphuric acid is ordered to dissolve the quinine sulphate, and the fluid extract of licorice to cover its intense bitterness (being one of the best of agents for this purpose), but the prescriber has overlooked the fact that acids will precipitate the glycyrrhizin in the fluid extract of licorice, the real flavoring principle of the root, and thus the very object which he is seeking, a clear and palatable mixture, will be defeated.

To omit the acid is the only remedy for this. The quinine sulphate may be diffused through the mixture, and the licorice will then mask its bitterness. Dispense with a shake-label.

℞.	Hydrargyri chloridi corros	gr. i.
	Potassii iodidi	ʒii.
	Strychninæ sulphatis	gr. i.
	Tinc. cinchonæ compositæ	ʒii.
	Aquæ	ad ℥vi.—M.

The first two ingredients of this mixture form the well-known Mayer's precipitant — double iodide of mercury and potassium — which will precipitate the strychnine and the active principles of cinchona from aqueous solutions, but the precipitates are all soluble in alcohol; consequently this incompatibility may be overcome by using enough alcohol to hold these in solution.

In the above case we may dissolve the corrosive sublimate and potassium iodide in two drachms of warm water, and the strychnine sulphate in two drachms more of water, mix the strychnine solution with the compound tincture of cinchona and add half an ounce of alcohol, then add the iodide solution and shake well. This makes a three-ounce mixture instead of a six-ounce, and the dose should be marked *one half of that ordered*, but the mixture now contains enough alcohol to hold the strychnine and cinchona alkaloid in solution, and the patient will take scarcely any more alcohol than in the mixture as ordered.

Strychnine should never be dispensed in solutions with iodides or bromides unless alcohol or some suspending agent be present.

INFUSIONS AND DECOCTIONS.

These are much less frequently prescribed in America than in England and Europe, where their preparation is a daily task in the large stores.

Where they are frequently demanded conveniences for their preparation are kept at hand, but where only an occasional call is made for them they are more likely to be considered an annoyance.

They should not be considered merely as weak galenical preparations, though they are not as potent as other preparations. They differ materially from tinctures, fluid extracts, wines, etc., not only in strength, but also in taste and appearance, and oftentimes in action. This is because quite different principles are extracted from drugs by water than those which are obtained by alcoholic liquids. *In infusions and decoctions only the water-soluble principles are desired, and a diluted tincture or fluid extract is never a proper substitute.*

We all know the difference between a properly made cup of tea or coffee, and one made by diluting a fluid extract of tea or coffee with hot water. The latter lacks the refreshing qualities as well as the aroma and flavor of the former. So with drugs.

In digitalis, for instance, the infusion contains principles which are lacking in the tincture or fluid extract, and the superior results obtained by use of the infusion has long made it a favorite preparation of this drug.

Drugs containing volatile principles or principles easily injured by heat are best adapted for infusions, while drugs containing albuminous bodies, or principles not readily extracted, are made into decoctions. Cold infusions are prepared by percolation from drugs containing extremely volatile or sensitive principles (as infusion of wild cherry in which hydrocyanic acid is *developed* by cold water) or from drugs containing undesired principles which are not readily extracted by cold water (as infusion of cinchona).

The pharmacopœial directions for preparing infusions are as follows:

"Put the substance" (50 Gms. coarsely comminuted) "into a suitable vessel provided with a cover, pour upon it the boiling water, cover tightly, and let it stand for half an hour. Then strain, and pass enough water through the strainer to make the infusion measure 1000 Cc."

The strength of infusions is thus 5 per cent. (50 Gms. of drugs for 1000 Cc. of infusion), unless otherwise specified by the Pharmacopœia or the physician.

Earthenware vessels are best adapted for making infusions, because they are thick walled and hold the heat better than glass or metal. They are also not easily broken.

Infusion mugs are made, consisting of a cup-shaped vessel having a perforated basket or diaphragm of earthenware supported near the top, in which the drug is placed, and the boiling water is poured through this.

The full capacity of the mug should be made each time, the object of having the drug at the top of the mug being to allow of circulatory displacement as the maceration proceeds, thus insuring better extraction. The same result may be secured by tying the drug very loosely in a bag of thin cloth, which is then immersed just beneath the surface of the hot water. In the latter case an ointment pot, coffee cup, earthenware pitcher, coffee pot or any other suitable vessel which can be covered, may be used, and only the desired amount of infusion made each time. A tall vessel of suitable capacity should be selected. Straining is also unnecessary, the process being practically automatic. The bag should be of thin cloth, not too tightly woven, and the drug should be enclosed loosely, not pressed into a ball. The vessel, whether an infusion mug, or what, should first be heated by pouring into it some boiling water, which is allowed to stand a few moments, then thrown out just before the infusion-water is poured in.

Hard water will not make a good infusion, and only rain or distilled water should be used; the quality of the infusion will depend almost as much upon the use of a good soft water, as upon the quality of the drug.

No advantage is gained by macerating over-time, but deterioration may result from it, as in making tea or coffee, when an astringent or bitter taste is developed by prolonged heating. Complete extraction is not always desired, but only the extraction of certain principles.

Infusions should never be filtered. They spoil quickly, and should therefore be made fresh, and in small quantities. In a few cases (Infusion of Digitalis, Gentian Compound, etc.) a small proportion of alcohol is added to the infusion for the purpose of preserving it; but this should never be done without the sanction of the physician.

Concentrated infusions, made four or six times the strength of the official, are objected to in some cases for this reason. They are nearly always made to contain alcohol as a preservative, and this may be objectionable even in the small quantity which exists after diluting the infusion. Probably the best method of preserving infusions, concentrated or otherwise, is to proceed according to the rules of sterilization. First sterilize the bottle by the use of boiling water, which is allowed to stand in the bottle for some time; then pour in the infusion *while hot*, filling the bottle to the neck, and cork immediately. In this way infusions, made by the hot process, may be preserved for weeks, without material change. Concentrated infusions, if preserved in this manner, should be stored in small bottles, and the entire contents of a bottle diluted and used when opened.

They may be stored in large bottles, and the contents withdrawn as desired, by the method proposed by Prof. Almen, of Sweden.

The bottle is fitted with a stopper having two perforations. Through one of these perforations a vent-tube passes, reaching to just inside the bottle; the outer end of the tube is plugged loosely with absorbent cotton. The short end of a glass-syphon is passed through the other perforation, the long end being provided with a tap, made of a closely-fitting piece of rubber tubing and a pinch-cock.

The contents of the bottle are thus withdrawn through the syphon, and the air which enters the bottle is sterilized by filtering through the cotton. The apparatus requires to be sterilized each time before refilling, by means of boiling water.

Decoctions are directed to be made as follows: "Put the substance" (50 Gms. coarsely comminuted) "into a suitable vessel provided with a cover, pour upon it the cold water, cover it well, and boil for fifteen minutes. Then let it cool to about 40° C. (104° F.), express, strain the expressed liquid, and pass enough cold water through the strainer to make the product measure 1000 Cc."

The general strength of decoctions is thus the same as infusions, but the method of preparation differs. Decoctions are made by putting the drug into *cold* water, which is then brought to a boil, and the boiling continued for fifteen minutes, then allowed to cool and strained. Better extraction is thus obtained than if the drug were placed directly in boiling water. In the latter case albuminous bodies in the drug would be suddenly coagulated, and entangle some of the principles which it is desired to extract. This is avoided by the gradual heating. These albuminous bodies are not likely to be found in drugs adapted for infusion.

The apparatus used may be the same as that for infusion, with the double advantage of preventing any burning of the drug by having it suspended in the top of the liquid. This is quite likely to occur where the drug is allowed to settle at the bottom of the vessel. Metallic vessels are more desirable for decoctions than for infusions, owing to the necessity of heating by direct flame; but iron should not be used, because it produces a black coloration with tannins. With care, earthenware vessels are almost as convenient, and more cleanly.

Previous maceration of the drug in cold water is advantageous, but a prolonged boiling is injurious, because the principles are altered thereby. Violent ebullition is also to be avoided; a gentle simmering being all that is necessary.

A tall vessel is also better than a shallow one; and boiling is hastened by covering the vessel.

Since boiling water extracts vegetable principles more easily than cold water, some of these may be thrown out of solution on cooling:

straining is therefore performed at a definite (tepid) temperature, and any principles afterward deposited are diffused by shaking.

Decoctions are seldom clear and should not be filtered.

The precautions in the use of water, and preservation, alluded to under infusions, apply also to decoctions.

COLLYRIA AND HYPODERMIC SOLUTIONS.

Solutions intended for use in the eye or for hypodermic injections are generally simple in character, but require the most scrupulous care in their preparation.

A few specks of dust in the bottle, or a small bit of undissolved salt or other matter may cause intense pain and lead to serious results. Only distilled water should be used in the preparation of these solutions, and it is well also to rinse the bottle which is to contain the solution with distilled water before filtering the liquid into it. If more salt is ordered in a collyrium than can be dissolved in the quantity of solvent prescribed, a cold saturation should be made and the undissolved salt filtered out.

Likewise in making alum-curds, by shaking alum with milk or with the whites of eggs until coagulation ensues, powdered alum should not be used because it cannot be removed completely from the coagulum, and if retained the sharp edges will irritate the inflamed surface.

In preparing solutions for hypodermic use it should be borne in mind that these are to be injected directly into the circulation and the fluids should therefore be not only free from mechanical irritants, but also as free from germs (bacteria) as possible.

Some writers have advocated the sterilization of all such solutions and their containers, by subjecting them to the heat of boiling water for twenty minutes or more, but some bodies often prescribed in this form are injured by heat. Such are cocaine, atropine, eserine, etc.

In one of the large hospitals in Boston, all hypodermic solutions are made with 0.5 per cent. solution of carbolic acid.

Thymol (1 grain in 4 fluidounces) and corrosive sublimate (0.1 per cent. solution) have also been recommended, but such powerful antiseptics should not be used without the physician's knowledge and permission. (See the chapter on Sterilization.)

Many solutions of alkaloids do not keep well in distilled water and need a preservative agent to prevent fungous growths or a decomposition. Less active medicinal agents will suffice for this, and acetanilid, salicylic acid, boric acid and chloroform have been recommended. Of these three the last is to be preferred, and the solutions may often be better prepared with chloroform water as a solvent instead of distilled water. Since chloroform is so very slightly soluble, its use in this manner would rarely, if ever, be objectionable.

Alcohol should not be used in hypodermic solutions **where it is possible to avoid it,** because of the physiological and irritant action which it produces. Its place can usually be supplied by glycerin or oils which are unobjectionable.

A hypodermic injection of musk, for instance, may be prepared by adding tincture of musk to half its volume of glycerin, evaporating on a water bath until all the alcohol has been volatilized, then adding enough glycerin to make, when cold, a volume equal to the tincture employed. In the case of bodies insoluble in glycerin, a bland oil (olive or expressed almond oils preferred) may be used, as in the following prescription, special care being taken that the oil is bright and clear and free from any trace of rancidity:

℞.	Guaiacoli	5 G.
	Eucalyptoli	12 G.
	Iodoformi	4 G.
	Olei olivæ	ad 100 c.c.

M. Ft. solution. Sig. — For hypodermic use.

Mr. N. W. Yeadle has made **an excellent suggestion for the sterilization of bottles** which are to contain hypodermic solutions.

Just before using, he partly fills the bottle with a hot two per cent. solution of potassium permanganate, which is shaken well around the sides, then the bottle is rinsed thoroughly with distilled water.

Solutions placed in bottles so sterilized are stated to keep for months without change, and the process is applicable to all kinds of solutions. If the solution is made with oil, the last few drops of water remaining in the bottle are removed by rinsing with a little alcohol followed by ether.

LOTIONS, LINIMENTS, ETC., present no special difficulties, being practically mixtures for specific purposes.

Lotions frequently contain insoluble bodies which should be in a condition to diffuse easily when the liquid is shaken. Gums are sometimes added to emulsify camphors and resinous bodies, but should be used sparingly. The application of a thin mucilage to the skin is not agreeable where it is allowed to dry. Better results are obtained as a rule by means of very fine powders or precipitates.

Liniments may be oily, saponaceous or alcoholic liquids. The first partake of the nature of soft ointments and are applied by rubbing. The second are both stimulating and soothing. They are sometimes made extemporaneously by the admixture of an oil and an alkali, as in soap and lime liniments. The oil and alkali should be mixed at once instead of gradually, and vigorously shaken.

Alcohol favors the union of the oil and alkali and is frequently added for this purpose. Oleic acid also promotes saponification, and the addition of a few drops sometimes aids in the preparation of such.

When an alcoholic liquid is ordered with an alkali and an oil, the alcoholic body, or a portion of it, may be added to the alkali before shaking with the oil.

Alcoholic liniments are stimulating or anodyne, and are used mostly for painful affections, as sprains, bruises, neuralgias, etc. They present no difficulties unless an insoluble salt is ordered, or an aqueous fluid is directed to be incorporated. Sometimes corresponding alcoholic liquid can be substituted for the aqueous, in the latter case, as in solutions of iodin and ammonia.

Liniments should be plainly marked "For External Use" and dispensed in a poison bottle. Lotions which are to be used as injections are dispensed in the ordinary vials and marked plainly, but not marked poison unless so ordered on the prescription.

A red label is used for these by preference.

MIXTURES.

A. Simple Solutions.

1.

℞. Ferri citras . . . . ʒ ij
Aquæ . . . . ℥ ij
M. Ft. solut.
Sig. — Citrate of iron.

Warm the water, but do not heat to boiling, drop the citrate into it and agitate until dissolved. Do not powder the citrate in a mortar.

2.

℞. Zinci sulphas . . . . gr. iv
Sat. sol. boric acid . . . . . ℥ iv
M. Ft. collyrium.
Sig. — Eye drops.

Triturate the zinc sulphate and 73 grs. of boric acid with the water, gradually added, until the salts are dissolved, then filter. Or, heat 4 fluidounces of water to boiling, add the boric acid, stir until dissolved, cool, replace the water that evaporated, add the zinc sulphate and when this is dissolved, filter.

3.

℞. Acaciæ . . . . 34 Gm.
Liquoris calcis . . . . . . 30 Gm.
Aquæ . . . . ad. 100 Gm.
M. Ft. solut.
Sig. — Mucilage of acacia.

Weigh a 4 oz. wide-mouthed bottle, with a cork and a 3 inch square of thin cloth. Place the acacia in the cloth and run a stream of water with moderate force over or through it for a moment. Then tie the acacia in a bag of the wet cloth, and suspend in the bottle in which has been placed the water and lime water, so that the bag hangs just beneath the surface of the water. When the gum has all dissolved, remove the empty bag.

4.

℞. Chloroform . . . .
Distilled water, each a sufficient quantity.
Sig. — Chloroform water, U. S. P.

"Add enough chloroform to a convenient quantity of distilled water, contained in a dark amber-colored bottle, to maintain a slight excess of the former, after the contents have been repeatedly and thoroughly agitated. When chloroform water is required for use, pour off the needed quantity of the solution, refill the bottle with distilled water and saturate it by thorough agitation, taking care that there be always an excess of chloroform present."

Make 4 ounces, using 0.5 C.c. of chloroform.

5.

℞. Oil of bitter almond	1 C.c.
Distilled water	1000 C.c.

Sig. — Bitter almond water.

Dissolve the oil in the water by agitation.

6.

℞. Olei cinnamomi	0.20
Talci	1.50
Aquæ distillatæ	100.0

M. Ft. solut. s. a.
Sig. — Cinnamon water.

Rub the oil with the talcum in a mortar, gradually add the water, then filter, returning the first portions to the funnel until the filtrate comes through clear. Finally add enough water through the filter to make 100 C.c. of filtrate.

7.

℞. Olei menthæ piperitæ	0.20
Magnesii carbonatis	0.50
Aquæ destillatæ	100.0

M. Ft. solut. s. a.
Sig. — Peppermint water.

Rub the oil with the magnesium carbonate, gradually add the water, filter and pass enough water through the filter to obtain 100 C.c.

8.

℞. Olei anisi	0.20
Calcii phosphatis precip.	0.60
Aquæ destillatæ	100.0

M. Ft. solut. s. a.
Sig. — Anise water.

Rub the oil with the calcium phosphate, and proceed as above.

9.

℞. Olei gaultheriæ	0.20
Gossypii purificati	0.40
Aquæ q. s.	ad. 100.00

M. Ft. solut. s. a.
Sig. — Wintergreen water.

Drop the oil upon the cotton, distribute it well by picking. Place a small pellet of fresh cotton in the apex of a funnel, pack the oiled cotton over it, press down firmly, and pour water through the whole until 100 C.c. of percolate are obtained.

10.

℞. Olei fœniculi	0.20
Aquæ destillatæ	100.00

M. Ft. solut. s. a.
Sig. — Fennel water.

Drop the oil upon filtering paper, distributing it over as large a surface as possible, let the paper absorb it, then drop the paper into 100 c.c. of *warm* water, shake well two or three minutes, then filter.

11

℞.	Lime	12 Gm.
	Distilled water, a sufficient quantity.	
	Sig. — Lime water, U. S. P.	

"Slake the lime by the gradual addition of seventy (70) cubic centimeters of distilled water, then add three hundred and sixty (360) cubic centimeters more of distilled water, and agitate occasionally during half an hour. Allow the mixture to settle, decant the liquid and throw it away. Then add to the residue thirty-six hundred (3600) cubic centimeters of distilled water, agitate thoroughly, wait a short time for the coarser particles to subside, and pour the liquid, holding the undissolved lime in suspension, into a glass-stoppered bottle. From time to time shake the bottle, so as to keep the solution saturated."

Pour off the clear liquid when it is wanted for use.

Make 600 C.c. (or one sixth of the above quantity) and keep the liquid as cold as possible without freezing. *Do not filter.*

12.

℞.	Tincture of ferric chlorid	20 C.c.
	Diluted acetic acid	30 C.c.
	Solution of ammonium acetate	200 C.c.
	Aromatic elixir	100 C.c.
	Glycerin	120 C.c.
	Water, a sufficient quantity to make	1000 C.c.
M.	Sig. — Basham's mixture, U. S. P.	

"To the solution of ammonium acetate (which should not be alkaline) add, successively, the dilute acetic acid, the tincture of ferric chlorid, the aromatic elixir, and the glycerin, and, lastly, enough water to make the product measure one thousand (1000) cubic centimeters. This preparation should be freshly made when wanted."

Make four fluidounces.

13.

℞.	Solution of lead subacetate	30 C.c.
	Distilled water, a sufficient quantity to make	1000 C.c.
M.	Sig. — Lead water, U. S. P.	

"Mix the solution of lead subacetate with enough distilled water, previously boiled and cooled, to make the product measure one thousand (1000) cubic centimeters. Keep the solution in well-stoppered bottles."

Make four fluidounces. The solution should be clear. Only distilled water, free from gases, can be used in this preparation.

14.

℞.	Tannic acid	20 Gm.
	Glycerin	80 Gm.
M.	Sig. — Glycerite of tannic acid, U. S. P.	

"Weigh the tannic acid and glycerin, successively, into a tared porcelain capsule, avoiding contact with metallic utensils, and apply the heat of a water-bath, until the acid is completely dissolved. Then transfer the solution to a bottle."

Make one-tenth the quantity.

15.

℞.	Soap, in fine powder	70 Gm.
	Camphor, in small pieces	45 Gm.
	Oil of rosemary	10 C.c.
	Alcohol	750 C.c.
	Water, in sufficient quantity to make	1000 C.c.
M	Sig. — Soap liniment, U. S. P.	

"Introduce the camphor and the alcohol into a suitable bottle, and shake until the camphor is dissolved. Then add the soap and oil of rosemary, and shake the bottle well for a few minutes. Lastly add enough water to make one thousand (1000) cubic centimeters, and again shake until the liquid becomes clear. Set it aside, in a cool place for twenty-four hours."

Make 100 *C.c.*

16.

℞.	Ammonium carbonate, in translucent pieces	34 Gm.
	Ammonia water	90 C.c.
	Oil of lemon	10 C.c.
	Oil of lavender flowers	1 C.c.
	Oil of nutmeg	1 C.c.
	Alcohol	700 C.c.
	Distilled water, a sufficient quantity to make	1000 C.c.

Sig. — Aromatic spirit of ammonia, U. S. P.

To the ammonia water, contained in a flask, add one hundred and forty (140) cubic centimeters of distilled water, and afterwards the ammonium carbonate reduced to a moderately fine powder. Close the flask and agitate the contents until the carbonate is dissolved. Introduce the alcohol into a graduated bottle of suitable capacity, add the oils, then gradually add the solution of ammonium carbonate, and afterwards enough distilled water to make the product measure one thousand (1000) cubic centimeters. Set the liquid aside during twenty-four hours in a cool place, occasionally agitating. Keep the product in glass-stoppered bottles, in a cool place.

Make 100 C.c. The liquid should be nearly clear without filtration. If any considerable amount of salt remains undissolved after twenty-four hours, shake frequently until it dissolves.

17.

℞.	Tinct. ferri chlorid	ʒ ij
	Spt. etheris nitros	ʒ iv
	Mucilag. acaciæ	℥ i
	Syrupi q. s. ut ft.	℥ iij

M. Sig. — Coch. parv. t. i. d. post cibo.

Mix the iron with two drachms of syrup and the spirit of nitre with three drachms of syrup. Mix the mucilage with the remainder of the syrup and gradually add, first the diluted spirit of nitre, then the diluted tincture. May also be mixed by adding the spirit and tincture very slowly to the mucilage previously mixed with the syrup.

18.

℞.	Sodii bicarbonatis	ʒ iv
	Tinct. zingiberis	ʒ j
	Tinct. gent. comp	ʒ vj
	Aquæ menth. virid	℥ iij

M. Sig. — Capiat cochleare parvum post prandium.

19.

℞.	Potassii bromidi	gr. xv
	Spiritus ammon. aromat.	ʒ j
	Syrupi	ʒ ij
	Aquæ q. s. ad.	℥ ij

M. Ft. haustis. Sig. — Detur statim.

20.

℞.	Tinct. iodi	ʒ ij
	Glycerini	ʒ vj
	Aquæ	℥ j

M. Ft. solut. Sig. — "Iodin lotion."
Mix in the order written.

21.

℞.	Iodi	ʒ j
	Spiritus camphoræ	ʒ iv
	Acidi carbolici	ʒ ss
	Aquæ ammoniæ	ʒ iv

M. Sig. — For inhalation.

Dissolve the iodin and carbolic acid in the spirit of camphor and slowly add the aqua ammonia to this. (A clear colorless solution results.)

22.

℞.	
Potassii chlorat.	ʒ j
Acid salicylici	℈ j
Tinct. ferri chlor.	ʒ j
Glycerini	℥ j
Aquæ	℥ iv

M. Ft. gargar.
Sig. — "Salicylated gargle."

Dissolve the salicylic acid in the glycerin by aid of a gentle heat, and the chlorate in the water. Mix the two solutions and add the tincture of iron.

23.

℞.	
Sodii boratis	1.0
Aquæ camphoræ	30.0

M. Ft. collyr. Sig. — Eye water.

Dissolve *crystallized* borax in the camphor water.

(Powdered borax is often effloresced and will sometimes precipitate the camphor as well as leave a residue which will not dissolve.)

24.

℞.	
Ammonii chlorid.	0.250
Zinc sulphatis	0.500
Camphoræ	0.150
Aquæ destillat	40.0
Alcoholis	6.0

M. Ft. collyr. Sig. — Eye drops.

Dissolve the camphor in the alcohol, and the salts in the water; mix the two solutions and shake until the liquid has become clear, then filter.

(This preparation, with the addition of 0.040 gm. of Spanish saffron, macerated in the liquid for twenty-four hours, then filtered, is often prescribed under the name of "Collyrium Astringens Luteum.")

25.

℞.	
Quininæ sulphatis	gr. xx
Acidi lactici	m. xx
Aquæ destillatæ	ad. m. c.

M. Ft. solut.
Sig. — "For hypodermic use."

26.

℞.	
Ergotinæ	gr. xv
Acid carbolici	gr. iss
Aquæ destillat.	m. lxxv

Solve et filtra.
Sig. — For hypodermic injection.

27.

℞.	
Ætheris	℥ iss
Chloroformi	℥ j
Tinct. iodi	℥ ss
Tinct. camphoræ	℥ ss
Olei picis liquid	ʒ ij

M. Sig. — Inhale as vapor.

28.

℞.	
Hydrarg. chlorid corros.	gr. xvj
Collodii	℥ ss

M. Ft. solut.
Sig. — Apply as directed.

Corrosive sublimate dissolves very slowly in collodion. By dissolving it in half a drachm of warm alcohol and mixing with the collodion, the prescription can be dispensed quickly.

29.

℞. Sodii phosphatis . . . . ʒ iv
Glycerini . . . . ℥ iv Misce.

The substitution of liquefied sodium phosphate for the crystalline salt would make a presentable mixture.

30.

℞. Acid salicylici 1.0
Acid lactici 1.0
Acid acetici glac. 1.0
Collodii 20.0
M. Ft. solut.
Sig. — Corn and wart collodion.

31.

℞. Cydonii contusi . . . . . . gr. xv
Aquæ bullientis . . . . . . ℥ ivss
Ft. mucilago et adde.
Glycerini . . . . ʒ vj
Spiritis odorati (U. S. P., 1880) ℥ ss
M. Sig. — Toilet lotion.

(Make the mucilage by macerating the quince-seed in the hot water for three to four hours, then strain.)

32.

℞. Tinct. benzoini comp. . . . . ʒ j
Glycerini . . . . ʒ vij
M. Ft. solut.

33.

℞. Camphor, in coarse powder 200 Gm.
Cotton-seed oil . . . . . 800 Gm.
M. Sig. — Camphor liniment U. S. P.

Introduce the camphor and cotton-seed oil into a suitable flask, and heat gently until the camphor is dissolved. Make 50 Gms.

34.

℞. Cocainæ muriatis . . . . . . gr. v
Mentholi . . . . gr. v
Acidi carbolici . . . . gr. ij
Alboleni liquidi . . . . ℥ ij
M. Ft. nebula.

Cocaine alkaloid must be used in place of the hydrochlorate. A clear solution will then be obtained.

35.

℞. Resorcini . . . . gr. x
Mentholi . . . . gr. v
Camphoræ . . . . gr. v
Benzoinol . . . . ℥ iv
M. Ft. nebula.

Dissolve the resorcin in an ounce of almond oil (expressed) and the other ingredients in three ounces of benzoinol. Mix the solutions, and filter if necessary.

36.

℞. Heroini . . . . gr. v
Petrolati liquidi . . . . ℥ viij
M. Ft. nebula.

Dissolve the heroin in 4 ounces of expressed almond oil, and mix with 4 ounces of liquid petrolatum.

37.

℞.	Mentholi,	
	Thymoli	āā gr. x
	Olei eucalypti	ʒ ss
	Acidi carbolici	gr. vj
	Acidi borici	gr. x
	Petrolati liquidi	℥ j
M.	Ft. nebula.	

The boric acid will not dissolve, and should be omitted.

B. Compound Solutions.

38.

℞.	Arsenous acid	10 Gm.
	Diluted hydrochloric acid	50 C.c.
	Distilled water, a sufficient quantity to make	1000 C.c.
M.	Sig. — Valangin's solution, U. S. P.	

"Mix the diluted hydrochloric acid with two hundred and fifty (250) cubic centimeters of distilled water, add the arsenous acid, and boil the mixture until all the arsenous acid is dissolved. Filter the solution and pass enough distilled water through the filter to make the product measure one thousand (1000) cubic centimeters. Mix thoroughly."

Make 100 C.c.

39.

℞.	Arsenous acid, in fine powder	10 Gm.
	Potassium bicarbonate	20 Gm.
	Compound tincture of lavender	30 C.c.
	Distilled water, a sufficient quantity to make	1000 C.c.
M.	Sig. — Fowler's solution, U. S. P.	

"Boil the arsenous acid and potassium bicarbonate with one hundred (100) cubic centimeters of distilled water, until solution has been effected. Then add enough distilled water to make the solution, when cold, measure nine hundred and seventy (970) cubic centimeters, and, lastly, add the compound tincture of lavender. Filter through paper."

Make 100 C.c.

40.

℞.	Lime	65 Gm.
	Sugar	350 Gm.
	Water, a sufficient quantity to make	1000 C.c.
M.	Sig. — Syrup of lime, U. S. P.	

"Triturate the lime and sugar thoroughly in a mortar, so as to form a homogeneous powder, then add the mixture to five hundred (500) cubic centimeters of boiling water, contained in a bright copper or tinned iron vessel, boil for five minutes, constantly stirring, and then strain. Dilute the strained liquid with an equal volume of water, and filter through white paper. Then evaporate the filtrate, in a tared capsule, to seven hundred (700) grammes, allow it to cool, add to it enough water to make the product measure one thousand (1000) cubic centimeters and mix thoroughly. Keep the syrup in well-stoppered bottles."

Make 100 C.c. The syrup should be white, or nearly so.

41.

℞.	Hydrarg. biniodidi	0.400
	Potassii iodidi	6.000
	Aquæ	180.000
M.	Ft. Solut. Sig. — 2 C.c. per dose.	

To make the red iodid of mercury dissolve 0.240 Gm. of *corrosive sublimate* in 20 C.c. of hot water, and *6.3* Gm. of potassium iodid in 20 C.c. of water and mix the two solutions. Dilute with the remaining water.

$$(HgCl_2 + 2KI = HgI_2 + 2KCl.)$$

[0.24 Gm. of $HgCl_2$ and 0.30 Gm. of KI are required to make 0.40 Gm. of HgI_2.]

42.

℞. Hydrargyri biniodidi . . . . gr. ij
Syr. sarsaparillæ comp . . . . ℥ iij
M. Sig. — One teaspoonful 3 times a day.

The red iodide must be dissolved by aid of a few grains of potassium iodid (about 10 grains) and water (one drachm). It would be dangerous to dispense exactly as written.

43.

℞. Quininæ sulphatis 2.0
Acidi sulphurici dilut. . . . . . q. s.
Aquæ 60
M. Ft. solut. Sig.—Coch. med. omnia hora.

Mix the quinin with half the water, add acid drop by drop, until a clear solution is obtained and then add the rest of the water. State on the label how much acid was used.

44.

℞. Tinct. ferri chlorid . . . . . . ʒ j
Quininæ sulph. . . . . ℈ j
Acid sulphuric dil. . . . . q. s.
Aquæ. . . . . q. s. ad. ℥ ij
M.

No acid is needed, the quinine being soluble in the tincture of iron.

45.

℞. Iodi . . . . gr. iss
Potassii iodidi . . . . gr. iij
Syrupi aurantii . . . . ℥ j
Aquæ . . . . ℥ iij
M. Ft. solut.

Dissolve the potassium iodid in two drachms of water and the iodin in this solution. Add the syrup, then the remainder of the water.

46.

℞. Sodii boratis 3.0
Mellis 30.0
Misce fiat linctus.
Sig. — For sore mouth.

Honey acts upon borax in the same way as does glycerin, but less energetically.

Free boric acid and sodium metaborate is formed in the above by action of the glucose upon the borax.

47.

℞. Acid salicylici . . . . ʒ ij
Sodii boratis . . . . ʒ iij
Glycerini . . . . ℥ iiss
Aquæ . . . . ad. ℥ viij
M. Sig. — Gargle.

Dissolve the borax in the glycerin by aid of heat, add the salicylic acid and continue a gentle heat until dissolved, then add the water.

If the borax be dissolved in the water and the salicylic acid added, the latter will be dissolved, but will be thrown out of solution when the glycerin is added by reason of the decomposition of the borax. On warming a permanent solution is formed.

48.

℞. Tinct. tolutanæ . . . . ʒ ij
Syrupi senegæ . . . . ʒ iv
Acid acetici . . . . ʒ iss
Syr. pruni virgin . . . . . ad. ℥ iv
M. Sig. — A teaspoonful as required.

Add the tincture to the acid, then mix with the syrups. Acetic acid resembles alcohol in solvent powers.

49.

℞. Acid gallic . . . . ʒ j
Potass. citrat . . . . ʒ iss
Aquæ . . . . ℥ iv
M. Ft. solut.

The gallic acid is entirely dissolved by the potassium citrate solution.

50.

℞. Olei picis liquidi	ʒ ij
Magnesii carbonatis	ʒ ij
Aquæ	O i
Misce, filtra et adde	
Iodi	gr. x
Potassii iodidi	ʒ ss

M. Ft. solut.

Sig. — Use with inhaler.

Triturate the oil of tar with magnesium carbonate, add the water gradually and filter. Dissolve the potassium iodid in about half an ounce of this filtrate and the iodine in this solution, and mix with the rest.

51.

℞. Sodii salicylatis	ʒ ij
Tinct. ferri chlorid	ʒ ij
Acidi citrici	gr. v
Glycerini	ʒ vj
Ol. gaultheriæ	m. iv
Liq. ammonii citratis . . . ad.	℥ ij

M. Ft. solut. s. a.

Sig. — Salicylated iron mixture.

Dissolve the sodium salicylate and citric acid in the solution of ammonium citrate. Add the tincture of iron to the glycerin, then mix the two solutions; finally add the oil of wintergreen and shake well. (Salicylates are incompatible with tincture of iron, but precipitation is prevented by the ammonium citrate.)

C. Gaseous Solutions.

52.

℞. Ammonii carbonat	5.0
Acidi acetici diluti	100.0

M. Ft. solutio.

Sig. — "Spirit of Mindererus."

Select clear pieces of ammonium carbonate, weigh carefully, and add gradually to the acid contained in a capacious vessel.

53.

℞. Potassium bicarbonate	8 Gm.
Citric acid	6 Gm.
Water, a sufficient quantity to make	100 C.c.

M. Sig. — Solution of potassium citrate, U. S. P.

"Dissolve the potassium bicarbonate and the citric acid, each, in forty (40) cubic centimeters of water. Filter the solutions separately, and wash the filters with enough water to obtain, in each case, fifty (50) cubic centimeters. Finally, mix the two solutions, and, when effervescence has nearly ceased, transfer the liquid to a bottle. This preparation should be freshly made when wanted."

54.

℞. Magnesium carbonate	15 Gm.
Citric acid	30 Gm.
Syrup of citric acid	60 C.c.
Potassium bicarbonate	2.5 Gm.
Water, a sufficient quantity to make about	350 C.c.

M. Sig. — Solution of citrate of magnesia, U. S. P.

"Dissolve the citric acid in one hundred and twenty (120) cubic centimeters of water, and, having added the magnesium carbonate, stir, until it is dissolved. Filter the solution into a strong bottle of the capacity of about three hundred and sixty (360) cubic centimeters, containing the syrup of citric acid. Then add enough water to nearly fill the bottle, drop in the potassium bicarbonate, immediately close the bottle with a cork, and secure it with twine. Lastly, shake the mixture occasionally, until the potassium bicarbonate dissolves."

55.

℞. Acidi salicylici.
Sodii bicarbonatis . . . . . āā ʒ ij
Aquæ . . . . ℥ iij
M. Sig.—"Salicylate of soda solution."

Place the acid in a pint mortar, rub to a paste with water and slowly add the sodium bicarbonate.

In the above reaction about two and a half pints of CO_2 are liberated and the effervescence is too violent to control in a three-ounce bottle. The solution gradually darkens owing to thė excess of alkali present.

56.

℞. Potassii chloratis . . . . ʒ j
Acidi hydrochlorici . . . . . ʒ j
Aquæ destillatæ . . . . ℥ iv
M. Sig. — "Throat mixture."

Compound in two ways.

(*a*)—Place the chlorate in bottle, add the acid, agitate for a moment, then add the water gradually.

(*b*) — Dissolve the chlorate in the water and add the acid to this solution.

57.

℞. Potassii chloratis . . . . ʒ ij
Acidi hydrochlorici . . . . . ʒ ss
Spiritus gaultheriæ . . . . . . ʒ iiss
Syrupi . . . . ℥ iss
Aquæ . . . . ad. ℥ iv
M. Sig. — "For ulcerated throat."

(The presence of syrup and flavoring in this shows that it is not intended for a solution of chlorin gas.)

58.

℞. Sodii boratis . . . . ʒ ss
Sodii bicarbonatis . . . . . . ʒ ss
Acidi carbolici (cryst.) . . . . gr. vj
Glycerini . . . . ʒ ij
Aquæ . . . . ad. ℥ iv
M. Ft. solut.
Sig. — "Dobell's solution, N. F."

Dissolve the salts in about half the water, add the glycerin and the carbolic acid and lastly enough water to make four fluidounces.

59.

℞. Acid salicylic . . . . ʒ ij
Ammon. carbonat . . . . ʒ vj
Syrupi . . . . ℥ iij
Aquæ . . . . ad. ℥ viij
M. Sig. — Ammonium salicylate.

(Note the color.)

60.

℞. Ammon. chlorid . . . . ʒ j
Ammon. carbonat . . . . . . ʒ j
Vini ipecac . . . . ʒ j
Syrupi scillæ . . . . ʒ vij
Syrupi . . . . ℥ j
M. Sig. — Pro tusse.

Use powdered ammonium chlorid, and triturate the salts well with the syrup of squill, add the wine, warm to hasten the reaction, and when effervescence has ceased add the syrup.

D. Mixtures.

61.

℞. Potassii bromidi . . . . ʒ ij
Aquæ camphoræ . . . . ℥ ij
M. Ft. solut.
Sig.—"Bromide mixture." *Shake.*

Place in a bottle and shake until the bromid is dissolved. Do not filter.

62.

℞. Hydrarg. chlorid corros. . . . gr. vj
Aquæ bullientis . . . . ʒ ij
Liquoris calcis . . . . ℥ iv
M. s. a. Sig.—"Yellow wash." *Shake.*

Dissolve the corrosive sublimate in the boiling water, in a test tube, add to the lime water and shake.

63.

℞. Hydrarg. chlorid mitis . . . gr. xvi
Glycerini . . . . ʒ ss
Liquoris calcis . . . . ℥ iv
M. "Black wash." *Shake.*

Triturate the calomel lightly with the glycerin and add the lime water, constantly stirring.

64.

℞. Zinci chloridi 1.00
Hydrarg. subchloridi 0.50
Liquoris calcis 240.00
M. Ft. lotio. Sig. — "Zinc and Mercury wash."

Make the zinc chlorid for this by carefully measuring 5.5 C.c. of diluted hydrochloric acid, to which add about 1.0 Gm. of zinc oxid, then warm gently and filter through a very small filter. Add this solution to the calomel and lime water previously mixed. If the zinc chlorid be added to the lime water first, a *white* lotion results; if the calomel is added first, a *black* lotion will be obtained.

65.

℞. Cupri sulphatis,
Zinci sulphatis . . . . . . āā ʒ j
Liq. plumbi subacet . . . . . ʒ iss
Acid acetic dilut . . . . ʒ xiij
M. et filtra. Sig. — "Villate's solution N. F."

Dissolve the zinc and copper salts in the diluted acetic acid, add the solution of subacetate of lead and agitate thoroughly. Filter through a small filter. To the filtrate add one drachm of starch, shake well and again filter.

66.

℞. Zinci sulphatis 0.52
Plumbi acetatis 0.325
Tinct. catechu comp. . . . 4.0
Tinct. opii. 2.0
Aquæ 100.0
M. Sig. — Inject as directed. *Shake.*

Dissolve the zinc sulphate in 60 C.c. and the lead acetate in 30 C.c. of water. Mix the two solutions gradually with shaking. Then add the tinctures in order, and finally rinse the graduate with the remaining 10 C.c. of water.

67.

℞. Acid sulphurici,
Acid nitrici . . . . āā 5.0
Olei terebinthinæ 15.0
Alcohol 25.0
M. Ft. lotio.

Place the oil in a capacious porcelain capsule or mortar, under a hood or out of doors. Mix the acids and slowly add to the oil at arms' length. When the reaction is over and mixture has cooled, add the alcohol and bottle.

(This is liable to take fire if the acids are added too fast.)

68.

℞. Acid nitric,
Chloroformi,
Creosoti . . . . āā 5
M.

Mix the nitric acid and creosote in an open dish under the hood or in the open air, and when reaction has ceased and the mixture cooled add the chloroform.

69.

℞.	
Ferrous sulphate, in clear crystals	6 Gm.
Myrrh, in small pieces	18 Gm.
Sugar	18 Gm.
Potassium carbonate	8 Gm.
Spirit of lavender	60 C.c.
Rose water, a sufficient quantity to make	1000 C.c.

M. Sig. — Griffith's mixture, U. S. P.

"Rub the myrrh, sugar, and potassium carbonate, in a mortar, with seven hundred (700) cubic centimeters of rose water, at first very gradually added, so that a uniform mixture may result. Transfer this to a graduated vessel, add the spirit of lavender, then the ferrous sulphate, previously dissolved in about fifty (50) cubic centimeters of rose water, and, lastly enough rose water to make the product measure one thousand (1000) cubic centimeters. Mix the whole thoroughly. This preparation should be freshly made, when wanted."

Make four fluidounces of the mixture. (This mixture, ***without the iron***, keeps well, and is frequently so prepared in quantity. When required for use, 3 grains of granulated sulphate of iron are added to each ounce of mixture and well shaken for a few moments.)

70.

℞.	
Potassæ sulphuratæ,	
Zinci sulphatis	āā ʒ j
Ætheris,	
Alcoholis	āā ʒ x
Aquæ rosæ	℥ iss

M. Ft. lotio.

Dissolve the salts separately in ʒ vj of rose water, mix with stirring, and add the alcohol and ether. Dispense with a shake-label.

71.

℞.	
Bismuthi et ammonii citratis	ʒ iij
Acidi nitrici diluti	q. s.
Aquæ	ad. ℥ iv

M. Sig. — Teaspoonful as directed.

On adding diluted nitric acid to the bismuth salt, previously dissolved in the water, bismuth citrate is precipitated in a very fine gelatinous condition, which remains suspended for a long time. An excess of acid should be avoided — better a slight deficiency than an excess. In the above the salt may be dissolved in 2½ fluidounces of water, and 19 drachms of this precipitated with diluted nitric acid, then the remainder of the solution added. From 4 to 10 drachms of acid are required.

72.

℞.	
Bismuthi subnit.	4.0
Tragacanthæ pulv.	1.3
Alcoholis	8.0
Aquæ cinnamoni	ad. 120.0

M. Sig. — Bismuth mixture.

Place the tragacanth in a dry bottle or mortar, add the alcohol, mix well, then add 50 C.c. of cinnamon water, mix thoroughly and add the bismuth and the rest of the cinnamon water.

73.

℞.	
Ferri et potassii tartratis	4.0
Potassii bromidi	4.0
Syrupi	15.0
Aquæ destillatæ	ad. 60.0

M.

The first two ingredients are incompatible. Dissolve the iron salt in 25 C.c. of water and add the syrup. Dissolve the bromid in the remainder of the water and mix with the iron solution. This begins to precipitate after standing an hour (or less), but the decomposition is less rapid than if the two salts are placed together in the bottle.

74.

℞.	
Pulv. camphoræ	gr. xv
Sodii boratis	gr. x
Alcoholis	℥ ss
Aquæ rosæ	℥ iiiss

M. Ft. lotio.

Dissolve the camphor in the alcohol and the borax in the rose water.

Add the first solution to the second, and dispense with a shake-label.

75.

℞.	Aquæ ammoniæ	ʒ ss
	Spiritis camphoræ	♏ xxij
	Sodii chloridi	ʒ ij
	Aquæ	ad. ℥ iv

M. Sig.—"Sedative water." N. F.

Dissolve the salt in about two fluidounces of water, add the ammonia and the camphor, and enough water to make four fluidounces. *Shake.*

76.

℞.	Tinct. benzoini	10.0
	Aquæ destillatæ	150.0

M. Sig.—"Lac Virginis."

Pour the tincture slowly into the water, with constant shaking. This is used (diluted with water), as a toilet wash, and gum should not be used for emulsifying it. If the tincture is added slowly, a milky mixture results.

77.

℞	Potassii chloratis	ʒ j
	Tinct. opii camphoratæ	ʒ iv
	Tinct. benzoini comp.	ʒ iiss
	Syrupi tolutani	℥ j
	Aquam	ad. ℥ iv

M. Ft. garg.

Dissolve the potassium chlorate in two ounces of water. Mix ʒ ij of mucilage of acacia with the syrup, and gradually add the comp. tincture of benzoin with constant stirring. Then add the aqueous solution, and lastly the paregoric.

78.

℞.	Potassii chloratis	gr. xv
	Tinct. cinchonæ comp.,	
	Tinct. guaiaci	āā ʒ iss
	Melis	℥ j
	Aquæ menthæ piperitæ	ad. ℥ iv

M. Ft. garg.

Honey suspends resins better than syrup. The guaiac tincture should be added last and *very slowly*, with constant stirring.

79.

℞.	Sodium bicarbonate	35 Gm.
	Fluid extract of rhubarb	15 C.c.
	Fluid extract of ipecac	3 C.c.
	Glycerin	350 C.c.
	Spirit of peppermint	35 C.c.
	Water, a sufficient quantity to make	1000 C.c.

M. Sig.—Rhubarb and soda mixture, U. S. P.

Dissolve the sodium bicarbonate in about four hundred (400) cubic centimeters of water. Then add the fluid extracts, the glycerin, and the spirit of peppermint, and lastly, enough water to make one thousand (1000) cubic centimeters.

Make 4 fluidounces.

80.

℞.	Pure extract of glycyrrhiza	30 Gm.
	Syrup	50 C.c.
	Mucilage of acacia	100 C.c.
	Camphorated tinc. of opium	120 C.c.
	Wine of antimony	60 C.c.
	Spirit of nitrous ether	30 C.c.
	Water, a sufficient quantity to make	1000 C.c.

M. Sig.—Brown mixture, U. S. P.

"Rub the pure extract of glycyrrhiza, in a mortar, with five hundred (500) cubic centimeters of water, until it is dissolved. Transfer the solution to a graduated vessel containing the other ingredients, and rinse the mortar with enough water to make the product measure one thousand (1000) cubic centimeters. Mix the whole thoroughly."

Make 100 C.c. (Do not use *powdered* extract, but *pure* extract of licorice.)

81.

℞. Saponis hispan . . . . ℥ iv
Sodii carbonat . . . . ℥ ij
Sodii boratis . . . . ℥ j
Aquæ ammoniæ . . . . . . ℥ vij
Alcoholis . . . . ℥ iij
Ætheris . . . . ℥ ij
Aquæ . . . . ad. Cong. j
M. Ft. solut. Sig. — Cleansing fluid.

82.

℞. Compound chalk powder . 200 Gm.
Cinnamon water . . , . 400 C.c.
Water, a sufficient quantity
to make . . . . 1000 C.c.
M. Sig. — Chalk mixture, U. S. P.

"Rub the compound chalk powder, in a mortar, with the cinnamon water, and about two hundred (200) cubic centimeters of water gradually added, to a uniform mixture; transfer this to a graduated vessel, and rinse the mortar with enough water to make the product measure one thousand (1000) cubic centimeters. Mix the whole thoroughly. This preparation should be freshly made when wanted.

Make four fluidounces.

83.

℞. Quininæ sulph. 2.0
Ext. glycyrrhiz. fld. 10.0
Syr. zingiberis 20.0
Aquæ 30.0
M. Sig. — ʒ j ante cibum.

84.

℞. Chloralis . . . . ʒ j
Camphoræ . . . . gr. xv
Syr. zingiberis . . . . . . ℥ ss
Aquæ . . . . ℥ iss
M.

Pulverize the camphor and triturate with the syrup. Dissolve the chloral in the water and mix the two liquids. Do not triturate the chloral and camphor together.

85.

℞. Pulv. rhei . . . . ʒ j
Pulv. cinnamomi . . . . ℈ ij
Magnesiæ . . . . ʒ ij
Aquæ . . . . ℥ iv
M. Sig. — Rhubarb and magnesia mixture.

Triturate the solids with the water gradually added.

86.

℞. Saloli . . . . ʒ j
Mucilaginis tragacanthæ . . . ℥ ij
Aquæ . . . . ℥ iv
M.

Salol is not easily powdered by trituration, adhering to the pestle and sides of the mortar when rubbed. By dissolving the salol in alcohol, adding ʒ ij of powdered tragacanth and triturating with enough water to make 4 ounces, a presentable mixture is easily obtained.

87.

℞. Zinci oxidi . . . . ʒ ij
Spiritus camphoræ . . . . . ℥ iij
Liq. plumbi subacet. . . . . ʒ iss
Glycerini . . . . ℥ ss
Aquæ . . . . ℥ viij
M. Ft. lotio. Sig.—"For local use—shake."

Triturate the zinc oxid to a smooth paste with the glycerin, add the water, and lastly, the camphor and lead solution.

88.

℞.	
Iodoformi	3
Amyli	1
Glycerini	20
Aquæ	12

M. Ft. enema. Sig.—Inject as directed.

Mix the glycerin and half of the water and heat to 120° C. Mix the dry starch with the rest of the water and add to the hot mixture. Continue the heat until the starch is gelatinized, cool and incorporate the iodoform.

D. Decoctions and Infusions.

89.

℞.	
Wild cherry, in No. 20 powder	40 Gm.
Water, a sufficient quantity to make	1000 C.c.

M. Sig.—Infusion of wild cherry, U. S. P.

"Moisten the powder with sixty (60) cubic centimeters of water, and macerate for one hour; then pack it firmly in a conical glass percolator, and gradually pour water upon it until the infusion measures one thousand (1000) cubic centimeters."

Make four fluidounces.

90.

℞.	
Cinchona, in No. 40 powder	60 Gm.
Aromatic sulphuric acid	10 C.c.
Water, a sufficient quantity to make	1000 C.c.

M. Sig.—Infusion of cinchona, U. S. P.

Make four fluidounces.

"Mix the acid with five hundred (500) cubic centimeters of water, and moisten the powder with thirty (30) cubic centimeters of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it, first, the remainder of the mixture, and afterwards water until the infusion measures one thousand (1000) cubic centimeters."

91.

℞.	
Digitalis, bruised	15 Gm.
Alcohol	100 C.c.
Cinnamon water	150 C.c.
Boiling water	500 C.c.
Cold water, a sufficient quantity to make	1000 C.c.

M. Sig.—Infusion of digitalis, U. S. P.

"Upon the digitalis, obtained in a suitable vessel, pour the boiling water and allow it to macerate until the mixture is cold. Then strain, add the alcohol and cinnamon water to the strained liquid, and pass enough cold water through the residue on the strainer to make the product measure one thousand (1000) cubic centimeters."

Make 100 C.c.

92.

℞.	
Senna	60 Gm.
Manna	120 Gm.
Magnesium sulphate	120 Gm.
Fennel, bruised	20 Gm.
Boiling water	800 C.c.
Cold water, a sufficient quantity to make	1000 C.c.

M. Sig.—Black draught, U. S. P.

"Upon the senna and fennel, contained in a suitable vessel, pour the boiling water and macerate until the mixture is cold. Then strain with expression, dissolve in the infusion the magnesium sulphate and manna, and again strain. Lastly, add enough cold water through the strainer containing the senna and fennel to make the infusion measure one thousand (1000) cubic centimeters."

Make four fluidounces.

93.

℞.	
Sarsaparilla, cut and bruised	100 Gm.
Sassafras, in No. 20 powder	20 Gm.
Guaiacum wood, rasped	20 Gm.
Glycyrrhiza, bruised	20 Gm.
Mezereum, cut and bruised	10 Gm.
Water, a sufficient quantity to make	1000 C.c.

M. Sig.—Compound decoction of Sarsaparilla, U. S. P.

"Boil the sarsaparilla and guaiacum wood for half an hour in a suitable vessel with one thousand (1000) cubic centimeters of water. Then add the sassafras, glycyrrhiza, and mezereum, cover the vessel well, and macerate for two hours. Finally strain, and add enough cold water, through the strainer, to make the product measure one thousand (1000) cubic centimeters."

Make three fluidounces.

94.

℞. Acidi benzoici,	
Sodii boratis	āā ʒ ij
Infusi buchu	℥ vj

M. Sig. — Dessertspoonful in half a glass of water every three hours.

95.

℞. Quillajæ	ʒ iv
Rosæ Gallicæ	ʒ ij
Fiat infusum	℥ viij et adde
Saponis	ʒ j
Alcoholis	℥ iv
Glycerini	ʒ vj
Mentholi	gr. j
Thymoli	gr. ss
Olei aurantii	gtt. x
Olei cinnamomi	gtt. iij
Olei gaultheriæ	gtt. xv

M. s. a.

Sig. — Toothwash.

96.

℞. Chondri	gr. lxxij
Aquæ	℥ vj

M. Fiat mucilago. Sig. — Mucilage of Irish moss, N. F.

Select the moss, wash it with cold water, then place it in a capacious vessel, add 6 fluidounces of water, and apply heat until the water has boiled gently for 15 minutes. Then strain, and add enough water through the strainer to make the liquid measure, when cold, 6 fluidounces. If boiled in an open dish, water must be added from time to time to supply that lost by evaporation.

97.

℞. Chondri	ʒ j
Glycerini	℥ iss
Aquæ q. s. ut. ft.	℥ viij

M. S. a.

Wash the moss with water, then place in a suitable dish and pour upon it a quart of water. Apply heat and boil until the whole is reduced to about 6 fluidounces. Strain while hot, add the glycerin, and pass enough water through the strainer to make 8 fluidounces. (If bottled immediately this keeps well.)

98.

℞. Chondri	2.0
Aquæ destillatæ	75.0
Misce coque et cola, denique adde	
Aquæ bullientis	ad. 75
Glycerini	30
Alcoholis	15

M. Sig. — *Permanent* mucilage of Irish moss.

Select the Irish moss and boil half an hour in a capacious vessel, being careful not to scorch nor to allow to boil over. Keep up the volume with hot water while boiling.

CHAPTER V.

EMULSIONS.

An emulsion may be defined as an intimate mixture of immiscible fluids, or a fluid and an insoluble solid, by means of some intermediate agent.

They are milky-appearing mixtures, usually somewhat viscid, and often separate into two layers on standing. The term is usually applied to mixtures of oily, fatty, waxy or resinous bodies with water, but is also applied to intimate milky mixtures of fluids which are insoluble in each other (as chloroform, benzine, etc., with water), or sometimes to the suspension of an insoluble powder in water by means of an emulsifying agent.

Among the many branches of extemporaneous pharmacy, perhaps none is more of a bugbear to the average dispenser than the making of emulsions. If he be ignorant of the principles and rules governing emulsification, he quickly comes to look upon them as unstable mixtures of uncertain composition obtained by chance or unlimited muscle used in triturating or agitating.

The making of an emulsion, with a proper emulsifying agent, is, however, almost as positive and certain an operation as the making of a 50 per cent. solution of a salt, or of any other simple mixture.

Let us first consider **the theory of emulsification,** then the practical operations involved in making emulsions of different kinds.

If we place half an ounce of a fixed oil, as cod-liver oil, in a two-ounce bottle, add to it half an ounce of water and shake vigorously, the oil is broken up into globules and diffused through the water, and the mixture has an opaque appearance. On discontinuing the agitation, however, the oil and water quickly separate into layers again.

If now we place in another two-ounce bottle half an ounce of mucilage of acacia, turn the bottle so as to flow the mucilage around the inner sides, then add half an ounce of oil and shake vigorously, we obtain a whiter and more opaque mixture than before, which remains permanent for a period varying with the condition of the oil, the density of the mucilage, and the vigor of the shaking which we have given to it.

Here we have broken up the globules of oil as before, but the globules are much smaller than in the first experiment, and the mucilage creates an adhesion between the oil and the water in the mucilage and an emulsion ensues, although the difference in the specific gravities of the two liquids is greater than before.

It will be noticed that when the oil and water are shaken together, the oil is broken up much more than the water, or in other words the oil forms much smaller globules than the water. But when the mucilage is used, there is no perceptible difference in the sizes of the oil and the aqueous globules. This can be seen more readily by dropping water slowly into a column of oil, and into another portion of oil dropping mucilage of acacia, when it may be easily observed that the mucilage forms smaller drops than the water.

To secure a permanent emulsion then, two things are necessary: first to **get both the oil and the water into very minute globules, and second to prevent these globules from coalescing on standing.** The size of the globules, in any liquid, depends partly upon the vigor of the agitation, but more upon what is known as surface tension, or the cohesive properties of the liquid. Water has a higher surface tension than most other liquids, and so tends to form larger drops or globules, and a substance which will reduce its surface tension is needed. Then to prevent these small globules from running together and coalescing, first into larger globules and finally into separate fluids, some means must be employed to impart adhesion between the oil and water surfaces, so that they will remain in intimate contact.

The gum of the mucilage imparts both these properties to the water. It reduces the surface tension, and so forms smaller droplets of water, and it creates an adhesion between the oil and water surfaces that is stronger than the cohesive properties of either. So to form an emulsion, some agent is needed that will reduce the surface-tension of the water and cause it to form as small globules as the oil, when the two are agitated together, and then it must impart an adhesiveness between the oil and the water so that the globules of each will remain in a fine condition. If, in addition to this, it makes the water more viscous, that is an added advantage in securing permanency.

Most emulsifying agents also form a film or coating around the oil globules, which prevents their coalescing.

The permanence of an emulsion consists in obtaining the globules in so fine a condition that even a very thin mucilage can prevent their coalescing. These globules are ordinarily too small to be seen with the naked eye, but in emulsions made with a thick mucilage, as mucilage of tragacanth, or mucilage of Irish moss, the globules of oil may be distinctly visible to the eye and yet the emulsion remain permanent, owing to the viscosity of the mucilage which envelops them. Such emulsions, however, will not bear very much dilution.

The most difficult part of emulsion-making lies in getting the emulsion started. Thus, in making a pint of 50 per cent. emulsion it would be extremely difficult, if not impossible, to do it all in one operation, but by emulsifying a portion or the whole of the oil with a portion of the water and the emulsifying agent, we get a *primary emulsion* which can be diluted with oil, water or other solutions as desired.

Good emulsions often separate into layers after standing, but without showing any separated oil. An emulsion should not be condemned for this, because the separation is due not to faulty manipulation in making the emulsion, or to improper ingredients or proportions therein, but to excess of dilution, and a little shaking will quickly rediffuse it. The same thing occurs in milk — the best type of a natural emulsion — in which the true emulsion portion separates as cream. When separation of this *emulsion* occurs, we obtain the fat as butter.

In triturating an emulsion, no pressure is needed, but a rapid motion is essential. Five minutes of very rapid trituration will accomplish more in emulsifying an oil or balsam, than an hour of slow trituration. Indeed, if after five minutes or less of rapid trituration an oil does not emulsify, it is good evidence of some fault in the ingredients used, or of their proportions, and a satisfactory emulsion cannot be expected without alteration of the ingredients. This refers, of course, to small quantities of emulsion, involving a pint or less of oil. Large quantities require longer trituration.

The pestle should be held loosely between the thumb and first two or three fingers, and the motion imparted to it by means of the fingers and wrist, as well as those of the arm and shoulder. This will be found much less tiresome than when the pestle is grasped firmly with the whole hand, and the motion imparted from the arm and shoulder alone. The mortar should be of a capacity three to four times that of the quantity of emulsion which is being made, but the emulsion should be slopped up upon the sides as little as possible. Glass mortars are not suitable, the surface being too smooth. The emulsion may be stirred in either direction, or alternately. Alternating, or stirring first in one direction then in the other, is not desirable, however, except as a relief to the muscles, since emulsification is thought to take place a little quicker when stirred in one direction only.

Emulsifying machines are apparatuses for mechanical agitation. The smaller, hand machines, are usually an application of the Dover egg-beater in an enlarged form. For small quantities of emulsions, an egg-beater of any kind is an efficient substitute. The larger machines are more in line with the butter-churn, and indeed a churn is an excellent emulsion-machine. The principle of these is well imitated by a female piston-syringe, the oil and water mixture being repeatedly drawn into and forced out of the syringe, thus churning them together. All such appliances aid emulsification by breaking up the globules, and an egg-beater or a piston-syringe is easier to use than a mortar, and will often accomplish results that cannot be secured in the mortar.

Of late years **emulsions containing 90 or 95 per cent. of oil** have appeared upon the market. These are solid, cheesy bodies, not particularly agreeable to the palate, and they do not keep well. Some of them are soaps, or a combination of soap with the oil. Apparently the only advantage which these possess is that they may be quickly and easily diluted to any required strength, but this is quite offset in the average store by the losses occasioned through separation of the strong emulsion.

All emulsifiable bodies do not emulsify with equal ease. Fixed oils, as cod-liver oil, castor oil, seed oils, etc., emulsify more readily than volatile oils, as turpentine oil, the fragrant oils, etc. Many bodies, as creosote, camphor, some oleoresins, phosphorus, etc., cannot easily be emulsified alone, but can readily be made into an emulsion if first dissolved in a fixed oil, which is then emulsified. Almond oil (sweet) is an excellent solvent for this purpose, being bland and seldom rancid.

Heat will sometimes prevent the union of an emulsion. This is not liable to occur, though, except in cases where artificial heat has been employed.

Neutral salts, acids and acid salts, alcohol, glycerin, etc., are incompatible with emulsions. Small amounts of any of these may be combined (in solution) with an emulsion, if carefully manipulated. The oil should be thoroughly emulsified and the emulsion diluted as much as the formula will allow, then the salt solutions, alcoholic liquids, etc., added last and slowly. If separation begins, a few drops of water flowed down the pestle and quickly stirred in may restore it. Acids and acid salts are the most troublesome to add, particularly if the emulsion is made with a gum. Emulsions made with tincture of quillaja will mix with these easier. Alkaline salts usually assist in emulsifying, but it is safer to add these last when gum is present, as in case of neutral salts, since alkali salts sometimes act in the opposite way upon gum-emulsions.

A few organic solids are sometimes dissolved in oil which is then emulsified for administration. Such are salol (soluble in 2 parts of oil), aristol, iodoform and trional (soluble in 20 parts of oil), and sulphonal (soluble in 40 parts of oil).

Volatile bodies, as chloroform, ether, etc., should be emulsified by shaking in the bottle to prevent loss by evaporation, but non-volatile bodies are best emulsified in a mortar.

(Emulsion No. 128 offers a good object-lesson in the difference between the two methods.)

EMULSIFYING AGENTS.

As before mentioned, emulsifying agents are bodies that, when dissolved in water, reduce the surface tension of water and so make smaller droplets; and they also promote adhesion. Many of them also make a viscous solution, which is of much advantage in securing permanency. Viscous bodies flow slowly, and thus in a mixture will separate more slowly. It is for this reason that viscid agents are preferred for emulsions that are to be kept in stock, and are often used for this purpose though poor emulsifying agents.

It will be further noticed that *bodies which produce foam in watery fluids are usually good emulsifying agents.*

Emulsifying agents are chiefly albuminous, mucilaginous or saponaceous in character.

ALBUMINOUS AGENTS. — The albuminous agents are characterized by ease of manipulation, wide range of power, and palatability, but they do not keep well, and emulsions made with them soon spoil unless preserved by some antiseptic.

In milk and yolk of egg we have good examples of emulsions with an albuminous agent; milk being an emulsion of butter fat with *casein*, and yolk of egg an emulsion of a peculiar fat with *vitellin.*

Both **Milk** and **Yolk of Egg** are used as emulsifying agents, and are unexcelled as such except as regards keeping qualities. The propensities of milk to "sour" and of egg to become "stale" are well known, and these propensities are not changed by combining with them other fats or oils. But for emulsions which are to be taken immediately, nothing equals these agents for ease of manipulation or palatableness.

It has already been stated that it is much easier to dilute an emulsion already formed with additional oils or water, than to form an emulsion primarily.

Both milk and yolk of egg being natural emulsions, we would, therefore, expect that they would be easy of manipulation when used as emulsifying agents. Not only is this true, but they also emulsify successfully a larger variety of fatty bodies than other agents.

Milk, as ordinarily obtained, is seldom used except as a diluent. In this capacity it serves well for covering the taste of sharp or acrid bodies, as tinctures of capsicum, ginger, etc., and for many salts, chloral, etc. It is too weak of itself to be used to any extent as an emulsifying agent. The ordinary condensed milk of the market serves in this capacity admirably. This contains some sugar, which, however, does not interfere. In using it, the condensed milk is diluted with an equal bulk of water, then the oil is added in small portions, constantly triturating. An emulsion containing 84 per cent. of oil has been obtained by combining 6¾ ounces of cod-liver oil with 5 drachms of condensed milk, previously diluted with 5 drachms of water. This emulsion was of the consistency of lard, and kept well for a month.

Weaker emulsions may be obtained from the same mixture of condensed milk and water, by emulsifying a sufficient quantity of oil, then adding water gradually until the required bulk is obtained. These weaker emulsions do not keep as long as the stronger ones.

Glycerite of yolk of egg is an excellent form of the second to use. The oil should be added in portions to the glycerite in a capacious mortar, with constant trituration, and lastly the diluent may be added in the same manner. Both of these agents are used with excellent results for other bodies more difficult to emulsify than oils, such as creosote, chloroform, terebene, oleoresins, balsams, resinous tinctures, etc.

The appearance of the emulsion will depend largely upon the condition of the egg. When quite fresh, yolk of egg yields a creamy-white emulsion which shows no tendency to separate, but with old eggs, though they may show no signs of becoming stale, the emulsion is decidedly yellow, and in some cases may be deeply so.

For ease of manipulation, for palatableness, and for general utility, yolk of egg and condensed milk stand first among emulsifying agents. Their tendency to spoil, however, condemns them for general use, since emulsions made with either seldom remain palatable for more than a few days, and they are but little used. They have a special value, however, in emulsions of chloroform, creosote, and other antiseptic bodies, the preservative properties of which will prevent any change for several weeks.

Casein has been recommended as an emulsifying agent. It is, however, not easily obtained, and when procured possesses no advantage over acacia, so far as ease of manipulation is concerned.

It should be comparatively fresh, since it decomposes on standing. The moist (freshly precipitated and undried) casein, with a little sodium bicarbonate, gives the best results.

The dry casein is best prepared from skimmed (by centrifugal force) **milk,** since it is almost impossible to separate the fat from it when it is prepared from unskimmed milk. The skimmed milk can be easily obtained in all large cities and is also much cheaper. The casein is obtained by first adding ammonia water to the milk (about two fluidounces to a gallon) and allowing to stand 24 hours. Any creamy layer which has separated is then removed, and the casein precipitated from the serum by a slight excess of acetic acid. The magma is then collected and pressed, mixed with one-tenth its weight of sodium bicarbonate and dried at a gentle heat. (Too high a heat destroys it.) When thoroughly dried it is powdered and mixed with enough sugar of milk to make a 10 per cent. mixture of casein.

This mixture may be used for emulsifying in the same manner and proportions as powdered acacia, but does not yield as good results.

Pancreatin is a digestive body obtained from the pancreas of the hog. It consists of an albuminous body similar to casein, and four fermentative bodies, one of which has the power of digesting or decomposing fats and oils. It is always used in alkaline solutions, being decomposed by acids.

It may be used as an emulsifying agent in two ways: either by making a strong aqueous solution with which the oil is gradually combined, as in mucilage of acacia, or by warming the aqueous solution, at about 125° F., with the oil until the latter is partially digested.

By the latter method the oil is partially decomposed, and the resulting mixture is not properly an emulsion, although having the appearance of one. If heated too high the pancreatin will be decomposed.

Pancreatin is not a uniform body, and its emulsifying and digesting powers will be found to vary considerably.

Good pancreatin should emulsify eight to ten times its weight of cod-liver oil by the first method. It is not a good agent for emulsifying volatile oils.

ALBUMINOUS AND MUCILAGINOUS AGENTS. — A few bodies suitable for emulsifying are both gummy and albuminous in character.

Most prominent among these are certain seeds and Irish moss.

Most fleshy seeds contain a fixed oil associated with gummy and albuminous matter, and form an emulsion when deprived of their skins and beaten up with water. Pumpkin seed is sometimes dispensed in this manner. The skins may be removed by plunging first into hot water for a minute, then into cold, whereby the skin becomes loosened and may be slipped off. This is called "blanching" the seeds.

In almonds — a favorite seed for emulsions — there exists, in connection with the gum, a principle called *emulsin,* which assists in forming a smooth emulsion. This is partially destroyed by boiling water, and a better way of blanching almonds, when time will allow, is to soak the seeds for half an hour, or until the skins are loosened, in lukewarm water. Almonds have the advantage of adding flavor as well as emulsifying. In many other seeds there is found a ferment similar to emulsin which aids in emulsifying the oil. Hence hot water should be avoided in making seed emulsions.

In rubbing the seeds to a pulp a little water should be first added (about one part to ten parts of seed), since the pressure may force oil out of them if sufficient water is not present. The seeds should then be rubbed to a smooth, creamy paste, free from all lumps or gritty particles.

After diluting until quite fluid the liquid may be strained if necessary. Seeds which contain a large proportion of gum may be used as emulsifying agents.

Mucilage of Irish Moss has come into favor in recent years as an emulsifying agent. Its chief function is to impart viscosity and prevent separation of an aqueous layer in emulsions. It is not in itself a good emulsifying agent, and so is not much used alone, but possesses many advantages in economy and compatibility when used in combination with other emulsifying agents. It requires much more trituration than other agents, and does not yield as white and creamy an emulsion, commonly showing fine oil globules. The emulsion, however, does not separate for some time when well made. This oily appearance can be avoided by first emulsifying a portion of the oil with another emulsifying agent, and using the mucilage of Irish moss as a diluent rather than as an emulsifying agent. Neither the mucilage nor emulsions made from it keep well unless a preservative agent is added. The albuminous matter quickly ferments and putrefaction commences, giving off ill-smelling gases. This can be retarded for a long period or prevented altogether by substituting glycerin and alcohol for about a quarter of the water used in making the mucilage, or by substituting alcohol for a part of the water in diluting the emulsion, as suggested by the National Formulary.

Glycerin appears to aid rather than hinder its emulsifying powers. The mucilage of the National Formulary is quite thin. A much whiter and better emulsion can be made with a mucilage 50 per cent. stronger.

Emulsions with Irish moss can also be made easier and of a better appearance by addition of a little primary emulsion made with acacia or other emulsifying agent to the mucilage. Thus, in making a pint of emulsion, if half an ounce of the oil be emulsified first with ʒ j acacia, and this emulsion mixed with the mucilage of Irish moss, the oil afterward added will emulsify quicker and be whiter in appearance. The addition of two or three drops of solution of potassa to the mucilage, just sufficient to neutralize the acid present, also improves its emulsifying powers. A 90 per cent. emulsion of cod-liver oil can be made by using a mixture of equal parts of mucilage of Irish moss and condensed milk. The mucilage of Irish moss for this should be double the strength of the National Formulary mucilage, or 24 grains of moss to an ounce of mucilage. This emulsion does not keep as well as the 84 per cent. emulsion made with condensed milk and water. In making mucilage of Irish moss, only bright succulent pieces should be selected and the boiling continued for at least fifteen minutes. It should be boiled very gently in a capacious vessel to prevent frothing over. Irish moss is more easily combined with tincture of iron and acid than the mucilaginous agents.

Gelatin is recommended chiefly as an emulsifyer of petroleum oils. It resembles mucilage of Irish moss in properties and keeping qualities. Its best recommendation is its low cost. It may be used combined with alkaline salts or soft soap, in veterinary practice, etc.

MUCILAGINOUS AGENTS.

Gums or mucilaginous bodies are, as a class, the best for general use in emulsions.

They are capable of emulsifying well all bodies desired in emulsions, and the resulting emulsion keeps well under ordinary conditions. All true gums can be used as emulsifying agents. They form very fine, white emulsions.

Alkalies and borax must be added very cautiously to gum emulsions, since they tend to saponify the oil and break the emulsion. Borax also coagulates gums, but this can be prevented by the addition of sugar.

Gum-resins (ammoniac, asafœtida, myrrh, etc.) **form natural emulsions** when mixed with water. They consist of a gum associated with an oleoresin, and are never used as emulsifying *agents*, but are excellent types of gum-emulsions. When made from the whole drug they are milky in appearance, but if the powdered drug be used a dirty-brown mixture results, which quickly deposits a granular sediment, and leaves an almost clear, watery liquid. This is because the commercial powders are made from garblings, and these are further injured by long heating, which drives out all of the volatile oil, and completely changes the character of the drug. *Gum-resins cannot be powdered in large quantities without loss of their most valuable constituents.*

Small quantities of powder may be obtained for immediate use by taking advantage of the fact that extreme cold makes them brittle, and rubbing slowly in a well-chilled mortar and in cold air. The powder thus obtained will cake together again when it becomes warm.

The emulsions can be easily formed at ordinary temperatures by rubbing the *selected* pieces of drug with successive portions of water until all lumps are obliterated.

Acacia is the emulsifying-agent par excellence for general use. Emulsions made with it are attractive in appearance, palatable and permanent. Its range of power is exceeded only by the albuminous agents mentioned. Emulsions of chloroform, oleoresins, resinous tinctures, etc., can be made readily with acacia, but separate into layers quicker than when made with yolk of egg.

Either dry acacia or mucilage of acacia can be used for emulsions. Both have their advocates in point of preference, but dry acacia has proved itself a quicker and more certain agent to use, at least in the hands of novices. This is probably due to the fact that dry acacia must always be used in definite proportions, as must also the water first added. Two rules are in common use for making emulsions with dry acacia.

Rule 1. — **For one part of gum use four parts of fixed oil (or two parts of volatile oil), and once and a half as much water as gum.**

Rule 2 **varies only in using twice as much water as gum.** This rule may be easily remembered as **the 1, 2, 4 rule. — (Gum 1, water 2, oil 4).**

Exceptions to these may be met with in that the proportions of oil to gum vary with different oils; most fixed oils being emulsified well in proportion of four of oil to one of gum; while most volatile oils require one of gum to two of oil. Occasionally, however, a fixed oil is found which requires one third its weight of acacia, or a volatile body which requires an equal weight. The amount of dilution to which the primary emulsion is subject also affects the proportions. In all cases, once-and-a-half *or* twice as much water as gum must be used for the primary emulsion.

Suppose we wish to make a pint of 50 per cent. (by volume) emulsion of cod-liver oil.

This will require ℥viij of oil, and by the rules every four parts of oil (or ℥iv) will require one part (or ℥j) of gum; then the ℥viij of oil requires ℥ij of gum. Carefully weigh, then, the ℥ij of powdered acacia, place it in a *dry* mortar, having a capacity of Oiij or Oiv, and pour upon it the f℥viij of cod-liver oil. Triturate lightly until the acacia is diffused evenly through the oil, which will be accomplished in about a minute, if both acacia and mortar were dry.

Now lift the pestle, and having carefully measured f℥iv of water (Rule 2), pour it all upon the oil in the center of the mortar, then triturate rapidly until a perfectly white creamy mixture results, showing no globules or color of oil, and which has a crackling sound when triturated. This is called a *primary emulsion.* Then add to this slowly, with constant trituration, water enough to make a pint of emulsion. This emulsion is of the color and consistence of thick cream, and is permanent.

Failure only results in using this formula, from lack of care in measuring or weighing. *Approximate amounts will not do.* The acacia must be weighed accurately, and both the oil and water measured accurately and in clean graduates. Do not measure water or aqueous liquids in an oily graduate. The primary emulsion must always be made by means of oil, gum and *water; it cannot be made by using syrup, or a solution of a salt in place of the water.* Such solutions and other liquids can be incorporated with a primary emulsion, but cannot be used in making it. A failure has never been known to occur when these precautions have been observed.

The 50 per cent. emulsions of the market, however, seldom if ever contain as much acacia as this. In making them, advantage is taken of the fact that **the primary emulsion will emulsify an additional amount of oil,** if properly combined, without "breaking." This enables us to make this emulsion, using only half the amount of acacia in the formula just given.

Thus, instead of mixing *f*℥viij of oil, ℥ij of acacia and *f*℥iv of water for our primary emulsion, we may take half of the required amount of oil, or *f*℥iv of cod-liver oil, ℥j of powdered acacia and *f*℥ij of water, and make a primary emulsion as before. Then to this primary emulsion add the remainder of the oil, in portions of ʒij or ʒiij at a time alternating with portions of water ʒj or ʒiss each, and triturating each portion until thoroughly emulsified before adding the next. Finally, enough water is added, in portions, to make the finished emulsion measure a pint.

This requires but little more skill than the first method, and only half as much acacia, and makes a considerable saving in cost. Some prefer to use lime water, in place of the water, after making the primary emulsion. This has a saponifying action upon the oil, and yields an emulsion which does not as readily separate into layers.

Success with powdered acacia appears to depend more upon an exact proportion between the oil and the water in forming the primary emulsion than upon the proportion of acacia used.

Thus a primary emulsion may be made with **one** part of gum, **four** of oil and **two** of water; or with **one** of gum, **six** of oil and **three** of water; or with **one** of gum, **eight** of oil and **four** of water. In each case it will be noticed that **exactly** half as much water as oil must be used. But it cannot be said that half as much water as oil must be employed in all cases, for in some cases a larger proportion of gum is needed, and the quantity of water must be sufficient to dissolve all the gum. The following statement may be depended upon in all cases:

RULE. **When the proportion of gum used is one fourth that of the oil, or less, use half as much water as oil; when the proportion of gum to oil is greater than one fourth, use twice as much water as gum.**

In using mucilage of acacia, the mucilage is placed in a dry mortar, and the oil added in small portions, each portion being thoroughly emulsified before adding the next. One ounce of mucilage will easily emulsify two ounces of cod-liver oil, with the addition of a little water near the end of the emulsification.

Often a failure is made in this through the breaking of the emulsion while adding the last portions of oil. A little calculation will show the cause. One ounce of mucilage having a specific gravity of 1.25 will weigh an ounce and a quarter, and contains 34 per cent. of gum, or about 200 grains. This amount of gum will emulsify, according to the rule, about ʒxiii of the oil. Then, after adding ℥xiii of oil to the mucilage, the remainder of the oil should be alternated with portions of water, half as much water as oil, as in making the 50 per cent. emulsion.

Mucilage of acacia, when used for emulsions, must always be fresh. The slightest trace of sourness may prevent its forming an emulsion.

When other emulsifying agents are prescribed in combination with acacia, a mucilage may be made with the combined emulsifiers, and the oil gradually incorporated, or a primary emulsion may be made with the acacia and a part of the oil, to which are added first the other agents, then the remainder of the oil, with a little water if needed.

Acacia can be used to advantage in **emulsifying resinous tinctures** when mixed with aqueous fluids. The amounts to use will vary somewhat with the strength of the tincture and the amount of dilution.

Tincture of Benzoin, simple or compound, can generally be emulsified with half its volume of mucilage, while ammoniated tincture of guaiac requires nearly or quite its own volume of mucilage.

The mucilage should be diluted with water to prevent precipitation of gum in the mucilage by the alcohol in the tincture, then the tincture added gradually with constant trituration.

The addition of a little gum or mucilage to mixtures containing resinous tinctures, though not directed on the prescription, is often justifiable, and in the line of elegant pharmacy.

Wax, spermaceti, etc., may be emulsified by melting in a hot mortar, adding an equal weight of powdered acacia, then one-and-a-half times as much *hot* water, and triturating until a primary emulsion is formed, which may afterwards be diluted with warm water. Yellow wax should be used, as it makes a better emulsion than the white. Copaiba requires one third to one half its weight of acacia. But soap or quillaja is preferred for wax and resinous bodies for emulsions which are to be used externally.

Tragacanth is, next to acacia, the most popular emulsifying agent. It is a type of the "insoluble gums," and consists of a small proportion of true gum which dissolves in water and forms a very tenacious mucilage, and a large proportion of *bassorin,* or insoluble gum, which swells enormously in water, but does not dissolve.

Thus a mucilage of tragacanth, if made by treating one part of the gum with twenty parts of water, is a thick, gelatinous semi-solid, which is capable of occluding a large amount of oil, the bassorin being an obstacle to coalescence rather than a good emulsifier for the oil.

It forms dense emulsions, which are not as white and creamy as those made with acacia, and will not bear as much dilution. Tragacanth is capable of emulsifying 40 to 50 times its weight of oil, but it is not often used alone, as the emulsions are too thick to be agreeable. It is frequently combined with acacia as a means of cheapening the emulsion, and also to prevent separation into layers by thickening it. It is not as effective as Irish moss for thickening emulsions and preventing separation into layers. For some reason, not understood, acacia liquefies a tragacanth emulsion, and the tragacanth must be used in large excess to be efficient. Various proportions of tragacanth and acacia may be made into a mucilage into which the oil is stirred, as in using mucilage of acacia.

In making an oil emulsion with tragacanth, a mucilage should be first formed, into which the oil is gradually stirred as in using mucilage of acacia.

In emulsifying chloroform, resinous tinctures, and all alcoholic or ethereal fluids, the best results are obtained by placing the powdered tragacanth in a dry bottle, to which the fluid is added, and then, after shaking, about 20 times as much water as gum and the whole shaken vigorously. If oil is to be incorporated it must be added to this mucilage, and not to the dry gum.

Tragacanth is specially useful for suspending heavy powders, like bismuth subnitrate, etc., in mixtures. About 70 grains to a pint of mixture is sufficient, and it is best used after wetting the tragacanth well with half an ounce of alcohol, then adding the water.

Dextrin has been recommended by the National Formulary. Only white dextrin should be used, and this is difficult to obtain of good quality. Owing chiefly to this difficulty emulsions made with dextrin are not very common.

Extract of Malt is sometimes used as an emulsifying agent, and may be classed among the gummy agents, since it contains gum and some dextrin. The thick semi-solid extract is used for this purpose, the oil being added gradually to it in a warm mortar with trituration. It yields a brownish emulsion, which quickly separates into layers, but does not separate oil. Its taste is enhanced by the malt, and probably the action of the diastase upon the oil is of value. It should not be used unless directed, however, since extract of malt has a therapeutic action of its own which may be undesirable. Extract of malt is frequently acid, which interferes with its emulsifying powers. The addition of a little bicarbonate of soda will correct this, and improve its effects. It is an excellent agent for cod-liver oil, and for resinous bodies like asafœtida (tincture) ammoniated tincture of guaiac, compound tincture of benzoin, etc. A moderate heat helps the emulsion to form.

Extract of Licorice is also used. The powdered extract is usually employed, it being first triturated to a paste with water or (preferably) syrup, then the oil added gradually. It does not make a very fine emulsion, and oil globules are usually observable on close inspection. The emulsion must be made quite thick and stiff or separation of oil is likely to take place. It resembles tragacanth in its emulsifying efficiency, but being dark in color the coarseness of the emulsion is not so noticeable. It is one of the best agents to disguise the taste of cod-liver oil.

SAPONACEOUS AGENTS.

These are of two kinds, the saponin emulsions, and the soaps. Emulsions with this class of agents are best made by shaking in a bottle. They are very easy to make, and are most desirable in emulsions of fats and waxes which are to be used externally, as in treatment of skin diseases, etc.

Quillaia, or soaptree bark, contains a principle called saponin, which has the property of emulsifying oils and other bodies. It is this same principle which causes the frothing in preparations of sarsaparilla and senega.

Tincture of quillaia is one of the easiest emulsifying agents to use, and has a wide range of power, forming good emulsions with nearly all of the emulsifiable bodies. Even mercury may be emulsified (?) with it by gentle shaking. The usual *modus operandi* is to place the tincture in a dry bottle and add the oil to it in portions, shaking vigorously after each addition. The National Formulary gives a formula for preparing an emulsion in this way containing eighty-five per cent. of cod-liver oil, one part of the tincture emulsifying 8 ½ parts of oil. Volatile oils require a much larger proportion of the tincture, sometimes an equal volume.

Quillaia is especially useful in emulsions containing free acid, which interferes seriously with other emulsifying agents. Its acrid taste and irritating properties, however, which are noticeable in an emulsion, are a decided objection to it for internal use.

Tincture of Senega may be used in place of tincture of quillaia, and is less acrid. This is especially useful when an expectorant can be given with the oil, but should not be used where this is contraindicated.

Soaps and Alkalies. — Soap is seldom desirable for emulsions intended to be taken internally, but is often used for external preparations, as skin-creams, liniments, etc. A soap is a chemical combination of an alkali base with a fat or oil, the acids from the fat being combined with the alkali and a chemical salt or soap is formed. Soaps have the property of emulsifying additional portions of oil. Alkalies act in the same manner by first forming a soap with part of the oil, which then serves to emulsify more oil. Soaps are powerful emulsifying agents, particularly soft soaps. Soaps reduce the surface-tension of water very materially, a drop of pure water being 2½ times as large as a drop of a weak soap solution. Hence the emulsifying power of soap is very great.

They serve an excellent use in sprays, liniments, veterinary practice, etc. Soft soap and liniment of soft soap are convenient forms to use in making these mixtures. Alkalies will not emulsify volatile oils because these do not form soaps.

Linimentum Ammoniæ and Linimentum Calcis are good illustrations of these mixtures or soaps, made directly from alkali. Liniment of soft soap is sometimes added surreptitiously to gum-emulsions to prevent separating or to recombine oil already separated. If much has been added a frothing may be noticed when the emulsion is shaken.

Emulsions made with soap are incompatible with acids, which not only break the emulsions, but also decompose the soap.

Emulsions of Copaiba are often ordered made with an alkali. This forms a smooth emulsion which stands well. The alkaline action is specially desired, and the emulsion is rendered more compatible with alcoholic bodies than when gum is used.

No definite proportion of soap to be used can be stated, but it will be noted that only a very small proportion of soap is needed. When a hard soap is used, it is more efficient if combined with a little alkali, as borax, carbonate of potassium or sodium, or even caustic alkali. One part of soap (in solution) to 20 parts of fixed oil, or 10 parts of volatile oil, is probably the maximum proportion.

Woolfat is sometimes employed as an emulsifying agent for external preparations. It will emulsify a considerable proportion of a fixed oil, and it makes a very smooth emulsion. The woolfat should be melted and mixed with the oil, then warm water added gradually with constant agitation. These emulsions are easily made in a bottle, and can be diluted until quite thin without breaking.

Patent or secret emulsifiers are constantly appearing on the market. They appeal to the pharmacist because they are so easy to use; the emulsifier and oil is put into the bottle, water is added, and a short agitation produces a white and creamy emulsion. They usually consist of soap or saponin with some gummy or albuminous body. Professor Arny has given the following, as a type of these emulsifiers. A mixture of 1 Gm. (15 grs.) of tragacanth, 0.65 Gm. (10 grs.) of saponin, and 0.015 Gm. (¼ gr.) of saccharin forms the emulsifier. It is used in the proportion of 15 Grs. to an ounce each of oil and water, the oil being placed in a dry bottle, the emulsifier added, then the water.

Such mixtures are attractive in the ease with which they accomplish results, but neither soap nor saponin is desirable for internal use.

Prof. H. V. Arny recommends as the best "bottle-emulsifier," a mixture of equal parts of finely powdered gelatin, powdered tragacanth, and powdered sugar. Thirty grains of this is to be used for each ounce of oil. It requires a long shaking, but makes a white emulsion. It is essential that the gelatin be in fine powder.

GENERAL SUGGESTIONS.

Remember that water is as necessary as oil to form an emulsion, and the way it is used determines the success of the emulsion.

It is sometimes difficult to give up the notion that "oil and water will not mix," and to appreciate that in an emulsion we have overcome a law of repellence, but an emulsion is a triumph of skill, a combining of bodies which are naturally repellent.

This is accomplished, not by brute force or energy, but by judgment and skill in combining them. Emulsions are *coaxed* into being, not forced. The oil and water need a third body to get them to combine, to introduce them to each other, so to speak. What tact is to society, the emulsifying agent is to emulsion. It introduces the antagonistic bodies, overcomes their antipathies, brings them into intimate contact, and holds them together in harmony.

For general use, acacia is the best agent. More emulsions are made with it than with all other agents together. Most of the commercial emulsions, made on a large scale, are made with acacia. Powdered acacia is easier and more certain to use than mucilage of acacia. Powdered acacia increases the bulk of the liquid by about two thirds its weight when dissolved. That is, three ounces of acacia will occupy about the space of two fluidounces, when dissolved.

Tragacanth and Irish moss are excellent adjuncts to acacia, and are used more as aids than as independent emulsifying agents. Both need a long trituration or agitation to produce the best results. Commercial emulsions are churned six to ten hours before being bottled, and a smoothness and permanency is thereby secured which cannot be obtained in a short trituration.

On a small scale, 2 per cent of tragacanth in an emulsion will prevent more than a very slight separation of a watery layer or standing. It is best used in addition to the acacia, and more than 2 per cent. of tragacanth will not work as well as that amount. (This is ʒ v to O ij.)

A mucilage of Irish moss, made by boiling a drachm of moss in a pint of water for 15 minutes, is a cheaper and more efficient thickener. It needs a preservative to keep it. In either case, the longer the emulsion is stirred or churned, the smoother and whiter it will be. For hand work, an emulsifying machine, or an egg-beater, used at intervals during two days, will repay the cost.

In making and in stuffing (with oil) a primary emulsion, a creamy white appearance, and a crackling sound, are the signs of a good condition. If the emulsion becomes dull and darkens, losing its stiffness, add a very little water immediately and stir rapidly until it becomes white and thick, and crackles again.

Emulsions made with extract of malt should be *warm but not hot* when they are put together. The emulsion forms more rapidly and better in a warm mortar.

Emulsions of volatile oils, waxes, resins, etc., made with acacia, are improved by the addition of a fixed oil. The fixed oil thickens the emulsion and makes it smoother. The gum must be calculated for both the volatile oil and the fixed oil. For instance, if half an ounce of volatile oil is to be emulsified, and an ounce of fixed oil added to render it smooth, the volatile oil will need ʒij of acacia and the fixed oil will require ʒij additional, or ʒiv in all.

Resinous bodies for internal use need an equal weight of acacia, partly because they are highly diluted, and a larger proportion of acacia is needed when the emulsion is diluted.

Waxes and resins, emulsified for external use, are best emulsified with soap and alkali, or with quillaja.

Solid organic compounds, such as salol, iodoform, sulphonal, etc., are dissolved in a fixed oil which is then emulsified. They act more promptly when administered in this way. Salol dissolves in twice its weight of almond oil. The others need ten to twenty times their weight of oil to dissolve them. Aristol, iodoform and trional require 20 parts of warm oil, and sulphonal 40 parts to dissolve.

Flavors are needed to make emulsions palatable and need judgment in the using. The National Formulary gives a number of aromatic mixtures which can be employed with good effects. The aromatic and pungent flavors do not disguise an oil as well as softer flavors. For cod-liver oil, malt extract or licorice extract, with just a trace of clove or mint, are the most effective disguises. Coffee is largely used in Europe in cod-liver oil emulsions. Vanilla, chocolate, and tolu are also excellent, particularly the last two.

All these need sweetening to make them palatable. Syrup or sugar is best, and should be added to the emulsion after everything else is in. Sugar is not friendly to emulsions, and if used too freely it may break the emulsion. Saccharin, in the proportion of a quarter of a grain to an ounce of oil, is recommended. Sometimes a combination of sugar and saccharin is to be preferred.

EMULSIONS.

99.

Ammoniac	40 Cm.
Water, a sufficient quantity to make	1000 C.c.

M. Sig. — Emulsion of ammoniac, U. S. P.

"Rub the ammoniac in a warmed mortar, with nine hundred (900) cubic centimeters of water, at first very gradually added until a uniform emulsion results. Then strain the mixture into a graduated vessel, and wash the mortar and strainer with enough water to make the product measure one thousand (1000) cubic centimeters." Make four fluidounces.

100.

Sweet almond	60 Gm.
Acacia, in fine powder	10 Gm.
Sugar	30 Gm.
Water, a sufficient quantity to make	1000 C.c.

M. Sig. — Milk of almond, U. S. P.

"Having blanched the almond, add the acacia and sugar, and beat them in a mortar, until they are thoroughly mixed. Then rub the mass with nine hundred (900) cubic centimeters of water, at first very gradually added, until a uniform mixture results. Strain this into a graduated vessel and wash the mortar and strainer with enough water to make the product measure one thousand (1000) cubic centimeters. Mix the whole thoroughly."

Make four fluidounces. Blanch the almond by soaking in warm water until the skins are loosened.

101.

℞.

Amygdalæ dulcis	20.00
Olei ricini	30.00
Sacchari	15.00
Aquæ q. s. ut. ft.	100.00

M. Ft. haustus. Sig. — Summatur statim.

102.

℞.

Hydrarg. bichlorid	gr. iv
Acid hydrochloric	ʒ j
Amygdal. amaræ	ʒ iv
Glycerin	ʒ iij
Tinct. benzoini	♏ xv
Aquæ amygdal. amaræ	℥ iv

M. s. a. Sig. — "Freckle lotion."

Blanch the almond and beat into a paste with the glycerin, to which gradually add ℥iij of the water. Place in a bottle and add the tincture of benzoin in very small proportions, constantly agitating. Lastly add the remainder of the water, in which the corrosive chloride and the acid have been dissolved.

103.

℞

Acaciæ pulveris	10
Sacchari pulveris	30
Olei morrhuæ	60
Aquæ	ad. 120

M. Fac. emulsionem. Sig. — Capiat ʒ j pro doso.

(*a*) Make a primary emulsion with the acacia, 40 C.c. of oil and 15 C.c. of water, add the remainder of the oil in portions, alternating with portions of water, and lastly add the sugar dissolved in the remainder of the water.

(*b*) Make a mucilage with the acacia and 20 C.c. of water; in this dissolve the sugar, and then add 40 C.c. of oil in portions, thoroughly emulsifying each portion before the next is added. Then add the rest of the oil alternately with water.

104.

℞.

Olei jecoris aselli	32
Olei gaultheriæ	0.30
Fiat emulsionis	64

M. Sig. — "Acacia emulsion."

Make according to the rule for emulsions, using 8 Gm. of powdered acacia. Also make using 4 Gm. of powdered acacia.

105.

℞.

Olei jecoris aselli	30.0
Mucilaginis acaciæ	15.0
Olei gaultheriæ	0.5
Aquæ menthæ viridis	15.0

M. Sig. — 8 C.c.

Place the mucilage in a mortar and gradually add 20 C.c. of cod-liver oil, triturating thoroughly after each addition. Then add the remainder of the oil in portions of 2 to 3 C.c., alternating with 1 to 1½ C.c. of spearmint water; lastly add the oil of wintergreen and the remainder of the spearmint water.

106.

℞. Olei morrhuæ	℥ j
Glyceriti vitellæ	ʒ ijss
Aquæ	ad ℥ ij

M. Sig. — "Glyconin mixture."

Add the oil gradually to the glycerite, with constant stirring; lastly, add the water.

107.

℞. Fresh yolk of egg	45 Gm.
Glycerin	55 Gm.

M. Sig. — Glyconin, U. S. P.

"Rub the yolk of egg, in mortar, with the glycerin, gradually added, until they are thoroughly mixed."

Make ten grammes.

108.

℞. Olei morrhuæ	℥ j
Mucilaginis chondri (N. F.)	ʒ v
Aquæ	ʒ iij

M. Sig. — "Carrageen mixture."

Place the mucilage in a pint mortar and triturate with the oil, added very slowly and in portions, taking care that each portion is well emulsified before adding the next. Lastly, add the water.

109.

℞. Olei morrhuæ	30.0
Mucil. chondri	15.0
Aquæ amygdal. amar.	15.0

M. Signa. — Tablespoonful.

Use the "permanent" mucilage of Irish moss for this.

110.

℞. Olei morrhuæ	ʒ vij
Tinct. quillajæ	ʒ ij
Syrupi	ʒ j

M. Sig. — "85 per cent. Emulsion, N. F."

Place the tincture in a dry bottle, gradually add the oil, and emulsify; lastly, add the syrup.

111.

℞. Olei morrhuæ	℥ j
Mucilag. dextrini (N. F.)	ʒ v
Aquæ	ʒ iij

M. Sig. — "Dextrin emulsion."

Make in same way as carrageen emulsion.

112.

℞. Olei morrhuæ	℥ ij
Ext. glycyrrhizæ pulv.	ʒ ss
Confect. amygdal.	gr. xij
Spt. lavand. comp.	ʒ j
Spt. menth. pip.	♏ xxxv
Syr. tolut.	ʒ vij

M. Sig. — Black mixture.

Triturate together the extract of licorice and confection of almond, mix well with the syrup of tolu, and add to this slowly the cod-liver oil with constant trituration. When all is emulsified add the spirits in portions. This forms a dense, black, permanent emulsion, in which the taste of the cod-liver oil is quite effectually masked.[1]

(The confection of almond is made by mixing 6 Gm. blanched almonds, 1 Gm. of powdered acacia and 3 Gm. of sugar. This was formerly official as a basis for the preparation of emulsion of almond by simply triturating with water, but it does not keep well.)

113.

℞. Olei morrhuæ	50
Pulv. acacia	8
Pulv. tragacanthæ	2
Aquæ	ad 100

M. Ft. emuls.

Mix the acacia and tragacanth with 40 C.c. of water, add the oil and triturate until emulsified, then add water to make 100 C.c.

114.

℞.	Tragacanthæ pulv.	ʒ j
	Acaciæ pulv.	ʒ iss
	Marantæ	ʒ j
	Olei morrhuæ	℥ vj
	Aquæ	℥ vj
	Spiritus chloroformi	ʒ j
	Saccharini	gr. iij
	Olei cinnamomi	♏ ix

M. Fac. emulsionem.
Sig. — Ut dictum.

Put the powders in a dry mortar, rub to a smooth paste with a little oil, add the remainder of the oil, mix well, then add all of the water and triturate quickly until emulsified.

Dissolve the saccharin and oil of cinnamon in the spirit and incorporate.

115.

℞.	Olei morrhuæ	℥ iv
	Syr. pruni virgin	℥ ij
	Extracti malti	℥ j
	Vini xerici	℥ j

M. Ft. emuls.
Sig. — Malt emulsion.

Emulsify the oil by gradual addition to the extract of malt, in a warm mortar, alternating with the syrup. Lastly add the wine.

116.

℞.	Spiritus camphoræ	ʒ ij
	Spiritus chloroformi, Tinct. lavand. comp.	aa ʒ j
	Mucil. tragacanth	℥ j
	Aquæ	℥ iij

M. Sig. — Sedative mixture.

117

℞.	Olei ricini	℥ j
	Acaciæ pulv.	ʒ iij
	Olei amygdalæ amaræ	♏ ij
	Olei caryophylli	♏ j
	Liquoris saccharini	♏ iv
	Aquæ	ad. ℥ iv

M. s. a. Sig. — Pro alvo.

118.

℞.	Olei morrhuæ	℥ ij
	Vitelli	℥ j
	Sodii chloridi	gr. xij
	Liq. saccharini	♏ iij
	Olei caryophylli	♏ iij
	Aquæ	ad. ℥ iv

M. F. emulsio.

119.

℞.	Olei morrhuæ	℥ iij
	Liq. pancreatici	ʒ iv
	Mucilaginis acaciæ	ʒ iv
	Olei gaultheriæ	♏ xv
	Syr. calcii lactophosph	℥ j

M. Ft. emulsio.
Sig. — "Pancreatic emulsion."

Mix the pancreatic solution with the mucilage, add the oils gradually, and emulsify, and lastly, add ℥i of simple syrup, in which 15 grains of commercial calcium lactophosphate have been dissolved.

(The official syrup of calcium lactophosphate contains free acid, which is incompatible with the bicarbonate in the pancreatic solution.)

120.

℞. Acaciæ pulveris,	
Tragacanthæ pulv,	
Marantæ	aa ℥ ss
Pepsini saccharati	ʒ j
Olei morrhuæ	℥ iv
Olei cinnamomi	♏ iv
Olei sassafras	♏ iij
Olei amygdalæ amar	♏ j
Olei gaultheriæ	♏ iij
Glycerini	ʒ iv
Syr. hypophosph. cum ferro	ʒ v
Acid phosphorici dilut.	ʒ iij
Aquæ destillatæ	ad. ℥ viij

M. Fac. emulsionem.
Sig. — "Phosphatic emulsion."

Mix the gums, arrowroot and pepsin with ℥i of oil, add ʒvi of water and emulsify thoroughly, then add alternately the remainder of the oils and the water. Lastly, add the syrup and the acid previously mixed with the glycerin.

121.

℞. Misturæ olei terebinthinæ	60.0

(Each cl. to contain 1 C.c. oil turpt.)
Sig. — 1½ cl. ante edente.

Use acacia in proportion of 0.5 Gm. to each C.c. of oil.

122.

℞. Olei terebinthinæ	8.0
Pulv. tragacanthæ	1.0
Syrupi	15.0
Aquæ	q. s. ut. ft. 60.0

M. Ft. emulsio.

Place the oil in a dry bottle, add the tragacanth, shake, add 15 C.c. of water and shake vigorously until an emulsion results. Add the remaining ingredients gradually.

123.

℞. Ol. terebinthinæ	℥ j
Ovi recentis	no. j
Olei limonis	ʒ j
Acid acetici	ʒ v
Aquæ rosæ	℥ ijss

M. Sig. — "Stokes' liniment." *Shake.*

Triturate the egg and oils together in a mortar until they are thoroughly mixed, then incorporate the acid and rose water.

124.

℞. Chloroform	40 C.c.
Expressed oil of almond	60 C.c.
Tragacanth, in very fine powder	15 Gm.
Water, a sufficient quantity to make	1000 C.c.

M. Sig. — Chloroform emulsion, U. S. P.

"Introduce the tragacanth into a perfectly dry bottle of sufficient capacity, add the chloroform, and shake the bottle thoroughly, so that every part of the surface may become wetted. Then add about two hundred and fifty (250) cubic centimeters of water, and incorporate it by vigorous shaking. Next add the expressed oil of almond, in several portions, shaking after each addition, and when the oil has been thoroughly emulsified, add enough water, in divided portions, shaking after each addition, until the product measures one thousand (1000) cubic centimeters."

Make four fluidounces.

125.

℞.

Bromoformi	ʒ ss
Tinct. tolutanæ	ʒ j
Mucil. acaciæ	ʒ ij
Syrupi	ʒ iv
Aquæ menthæ viridis . . . ad.	℥ ij

M. s. a. Sig. — "Bromoform mixture."

Place the mucilage and two drachms of syrup in a bottle, and *gradually* add, with vigorous shaking, the bromoform and tincture of tolu previously mixed. When completely emulsified, add the remainder of the syrup and the spearmint water, with constant shaking.

126.

℞.

Pulv. acaciæ	℥ j
Olei lini	ʒ xv
" cinnamomi	gtt. viij
" gaultheriæ	gtt. xv
Glycerini	ʒ vi
Syrupi	ʒ x
Spiritus frumenti	℥ ij
Acid hydrocyan. dil	gtt. x
Chloroformi	ʒ v

M. Sig. — Compound linseed emulsion.

127.

℞.

Ovi	no. iv
Sodii chloridi	gr. iv
Glucosi syr.	℥ ij
Mucilag. amyli	℥ iv
Lactis	℥ iv

M. Ft. enema. Sig. — Nutrient enema.

128.

℞.

Copaibæ	4.0
Mucilag. acaciæ	6.0
Olei gaultheriæ	0.250
Tinct. lavand. comp.	4.0
Aquæ destillatæ	45.0

M. Sig. — ʒ ij t. i. d. post edente.
Compound by two methods.

(*a*) Place the mucilage in the bottle, flow around the sides, add the copaiba and oil, shake well, add 5 C.c. of water, shake and gradually add the remainder of the water and lastly the tincture, shaking after each addition. Label "Bottle method."

(*b*) Place the mucilage in a mortar, add the oil, then the copaiba in portions, triturating actively, then the water gradually and lastly the tincture. Label "Mortar method."

129.

℞.

Copaibæ	8.0
Liquoris potassæ	2.0
Olei gaultheriæ	0.186
Glycerini	15.0
Aquæ cinnamomi q. s. ut ft.	60.0

M. Sig. — 4 p. r. n.

Place the solution of potassa, with 4 C.c. of cinnamon water, in a 60 C.c. bottle, add the copaiba gradually, shaking well, then the oil, glycerin and balance of the cinnamon water in order.

130.

℞. Ceræ albæ,	
Cetacei,	
Saponis pulveris,	
Sodii boratis	āā 1.0
Amygdalæ dulcis	15.0
Alcoholis	15.0
Aquæ amygdalæ amaræ	60.0

Misce et cola. s. a. Sig. — "Toilet cream."

Blanch the almonds by soaking in warm water (about 40° C.), for half an hour, and after removing the skins bruise in a large mortar and rub to a smooth paste with 20 C.c. of bitter almond water, then dilute with 20 C.c. of more of the water.

Melt the wax and the spermaceti and mix with the soap and borax in a small *warm* mortar, and gradually add 20 C.c. of *warm* bitter almond water. When cold mix the two emulsions, and add the alcohol. Strain through cheese-cloth.

131.

℞. Terebinthinæ Canadensis . .	ʒ ij
Chloroformi	♏ xx
Tinct. opii deodorat	ʒ ij
Spiritus gaultheriæ	ʒ j
Syrupi senegæ	℥ j
Syrupi tolutani	ʒ xviij

M. s. a. Sig. — A teaspoonful every 2 hours.

Weigh the Canada balsam into a bottle containing the chloroform and spirit, shake until the balsam is dissolved, then add the syrup of senega and shake vigorously until a smooth emulsion is formed. Then add the syrup of tolu in portions, and lastly the tincture.

132.

℞. Creosoti	2.0
Lactis concentrat	20.0
Ol. cinnamomi	0.65
Aquæ	ad. 100.0

M. Ft. emulsio. Sig. — "Creosote emulsion."

Triturate the condensed milk with an equal bulk of water, add the creosote and oil, triturate thoroughly, and incorporate the water gradually.

133.

℞. Emulsionis terebinthinæ Canadensis 2 per cent.	100.0

Sig. — "Fir balsam emulsion."

This can be made with acacia (2 Gm.), mucilage of acacia (6 C.c.), tragacanth (0.5 Gm.), glyconin (8 C.c.), or any of the other emulsifying agents.

"Chian" and other hard turpentines or balsams must first be dissolved in an equal or double volume of ether, and this mixture emulsified in the usual manner.

134.

℞. Petrolati	5
Olei amygdal. exp.	25
Acaciæ pulv.	2
Tragacanthæ pulv.	2
Aquæ	ad. 100

135.

℞. Terebeni,	
Ol. gossyp. sem.	āā ♏ clx
Pulv. acaciæ	ʒ vj
Pulv. sacchari	ʒ ij
Aquæ . . . . . q. s. ut fiat.	℥ iv

M. Ft. emulsio. Sig. — "Terebene emulsion."

136.

℞.

Terebeni	m. clx
Acaciæ pulv	gr. cl
Ol. menth. pip.	m. xx
Ext. glycyrrhizæ fld.	℥ j
Glycerini	ʒ ij
Aquæ	ad. ℥ ij

M. Ft. emuls. Sig. — Terebene emulsion.

Mix the terebene, oil and acacia in a dry mortar, add 135 minims of water and stir until the emulsion forms.

Add the glycerin and the remainder of the water gradually, and lastly, the fluid extract of licorice. (C. E. Dotey, Ph.G.)

137.

℞.

Paraldehydi	℥ viij
Vitelli	No. vj
Olei cassiæ	ʒ ss
Sacchari pulv.	ʒ j
Aquam.	q. s. ad. ℥ xvj

M. Sig. — Paraldehyde emulsion.

138.

Solution of Lime.
Linseed oil, of each, one volume.
Mix them by agitation.
Sig. — Carron oil, U. S. P.
Make two fluidounces.

139.

Ammonia Water	350 C.c.
Alcohol	50 C.c.
Cotton Seed Oil	570 C.c.
Oleic acid	30 C.c.

Mix.
Sig. — Volatile Liniment, U. S. P.

"Mix them by agitation in a bottle, which should be well stoppered. This liniment should be freshly prepared, when wanted."

Make two fluidounces.

140.

℞.

Olei ricini,	
Aquæ ammoniæ,	
Ammonii carbonat	āā ʒ j
Alcoholis	℥ iv
Aquæ q. s. ut ft.	℥ viij

M. s. a.
Sig. — "Volatile Shampoo."

141.

℞.

Paraffini duri	22
Sevi	3
Sapo mollis	2
Tragacanthæ	2
Glycerini	12
Olei lavandulæ	1
Aquæ bullientis	68

M. Ft. emuls.
Sig. — "Shaving cream."

Melt the paraffin and suet in a bottle, add the boiling water in which the soap has been dissolved, and skake vigorously until a smooth emulsion has been formed. To this add the tragacanth in portions, keeping the mixture hot. Lastly add the glycerin and oil, and shake while cooling.

142.

Whale Oil Soap	1 oz.
Kerosene Oil	2 Pints
Boiling Water	1 Pint

Mix. Label "Kerosene insecticide."

Dissolve the soap in the boiling water, add the kerosene, and churn them together by means of a large force syringe until completely emulsified.

(This is a standard insecticide. It is diluted with 3 to 10 parts of water and sprayed upon trees or shrubbery.)

143.

℞.	Sodii boratis	gr. xxv
	Saponis pulv.	gr. xv
	Olei theobromatis	ʒ ij
	Olei cocois	m. xv
	Aquæ rosæ	ad. ℥ v

M. Sig. — Cocoa Milk.

Triturate the oils and solids in a warm mortar, with ʒ iij of rose-water until thoroughly mixed, then dilute gradually with the remainder of the rose-water. Almond oil may be substituted for the cocoanut oil, if desired.

144.

℞.	Olei terebinth	ʒ iv
	Olei olivæ	℥ ij
	Saponis	℥ j
	Sodii chloridi	ʒ iv
	Aquæ ferventis	O j

M. Ft. enema.

Dissolve the soap in the warm water, mix the oils, and shake with the soap solution until thoroughly mixed.

145.

℞.	Camphoræ	1.00
	Pulveris acaciæ	2.00
	Decoctionis lini	250.00
	Ovi vitelli	no. j

M. Ft. enema. Sig. — Inject as directed.

Powder the camphor finely, add the acacia and yolk of egg, mix well and stir in the decoction of flaxseed gradually.

146.

℞.	Camphoræ	0.5
	Acaciæ	q.s.
	Aq. destillatæ	100
	Syr. althæa	20

M. Ft. emulsio.

Use 2.5 of camphor liniment, and emulsify with an equal weight of acacia.

147.

℞.	Camphoræ	1.0
	Tragacanthæ	1.0
	Syrupi	10.0
	Aquæ	50.0

M. Ft. emulsio.

148.

℞.	Salol	10.0
	Acaciæ pulv.	5.0
	Aquæ	ad. 50.0

M. Ft. emuls. Sig. — Salol emulsion.

Dissolve the salol in 20 C.c. of olive oil, add the acacia and 10 C.c. of water and triturate until emulsified. Lastly add the rest of the water.

149.

℞. Salol	ʒ j
Pulv. acaciæ	ʒ j
Pulv. tragacanthæ	gr. x
Tinct. tolutanæ	ʒ ijss
Syrupi tolutani	℥ j
Aquæ	ad. ℥ iij

M. Sig. — "Salol emulsion."

Dissolve the salol in ʒ ij of oil and emulsify.

150.

℞. Trional	1.00
Olei amygdalæ exp.	20.00
Acaciæ	4.00
Sacchari	8.00
Aquæ aurantii flor.	15.00
Aquæ amygdal. amar	10.00
Aquam	ad. 60.00

M. Ft. emuls.

151.

℞. Potassii chloratis	ʒ j
Tinct. cinchonæ comp.	ʒ iv
Tinct. guaiaci ammon.	ʒ iv
Acaciæ pulveris	q. s.
Mellis	ʒ iv
Aquæ	ad. ℥ iv

M. s. a. Sig. — Gargle.

152.

℞. Resinæ guaiaci	gr. xxiv
Acaciæ pulveris	gr. xij
Sacchari	gr. xxiv
Aquæ cinnamomi	ʒ ij

M. Sig. — "Guaiac mixture." *Shake.*

Triturate the solids together and add the cinnamon water gradually.

153.

℞. Zinci chloridi	gr. iij
Iodoformi	gr. jss
Acid salicylici	gr. ij
Adipis lanæ	ʒ ij
Olei amygdal. exp.	℥ iss
Aquæ	ad. ℥ iij

M. Sig. — Injection.

Triturate the wool fat with the oil, gradually added; dissolve or suspend the solids in the water, previously heated and stir into the oily mixture in portions. A smooth, viscid emulsion results. This can also be made in a bottle.

154.

℞. Ichthyoli	ʒ ij
Olei olivæ	℥ j
Liq. plumbi subacet	℥ j

M

Makes a smooth emulsion by any order of mixing.

155.

℞.	Calamini	ʒ ij
	Zinci oxidi	ʒ ij
	Olei olivæ	ʒ iv
	Sulphur præcip	ʒ ss
	Acidi carbolici	ʒ iii
	Aquæ	ad. O j

M.

Mix the powders with ʒ iv of water, add the oil and heat gently until the latter is saponified, stirring constantly. Then add the rest of the water, and lastly the carbolic acid.

CHAPTER VI.

CONFECTIONS, ELECTUARIES, JELLIES.

Confection (Lat. *Confectio-onis*), a paste or mass composed of medicinal agents with saccharine and flavoring matter, intended to be eaten, or dissolved in the mouth. Small lumps, of a size approximating some familiar object, are directed to be taken at a time. They are dispensed in jars, wide-mouthed bottles or impervious boxes.

Conserves (Lat. *Conserva-æ*), a confection containing only *fresh* (undried) medicinal agents. These must contain enough saccharine matter to act as a preservative.

Electuary (Lat. *Electuarium-ii*), a confection containing *dried* medicinal agents.

Jelly (Lat. *Gelatinum-i*), a glutinous translucent substance, intermediate between a liquid and a solid, intended (*a*) either to be swallowed from a spoon or (*b*) for external application. The latter are often opaque. (See under plasmas.)

Confections. — This term now includes both the true conserves and the electuaries, the latter terms being used rarely.

These preparations are less frequently demanded than formerly, having been displaced by lozenges. A class of preparations called "*pastes*" were also in use, which differed from the confections in containing gum, and in being of a firmer consistence, more like the pastilles or tabellæ of the present.

Jujube paste was made by dissolving 3 ounces of acacia in 4 fluidounces of water, adding 3½ fluidounces of syrup, evaporating to a very thick consistence and adding toward the last 1 fluidounce of orange flower water. The warm mass was then run into shallow pans to cool and stiffen, medicinal agents, flavoring, coloring, etc., being added while still fluid. This is cut into sheets or squares and forms the so-called "jujubes" of pharmacy.

They are still somewhat in demand in France.

The true confections are made by beating the moist drug (fresh rose-petals, etc.) with sugar until a smooth mixture is obtained, a little excipient being added at the last if needed.

Electuaries offer no difficulties in preparation. The dry powders are mixed in the usual manner by trituration or sifting, then the excipient is worked in so as to form a mass.

Honey or syrups are the most common excipients. For laxative electuaries the pulp of prunes, tamarinds, figs, currants, etc., are agreeable massing agents, and aid, to some extent, in the action of the electuary.

These are prepared by steaming the fruits until they are well softened, then rubbing through a sieve to remove the skins and seeds. Currant and prune pulps are particularly agreeable as excipients.

Jellies for internal use are confined almost entirely to the administration of fixed oils, wherein they have the advantage of diminishing the adhesion of these to the mouth, and thereby lessening their taste and nauseating qualities.

Castor oil or cod-liver oil may be administered in this way. The following formula for the preparation of these is taken from Parrish's Pharmacy.

Take of the fixed oil	1 ounce.
Honey and syrup, each	½ fluidounce.
Powdered gum arabic	2 drachms.
Russian isinglass	40 grains.
Aromatic water (bitter almond, orange flower, cinnamon, etc.)	6 fluidrachms.

Dissolve the isinglass by aid of heat in one-half ounce of the water, triturate the other ingredients into a homogeneous mixture with the remaining portion of the water in a warm mortar, then form an emulsion by adding the solution of isinglass, stir as it cools, and set aside to gelatinize.

Isinglass is the best base for oils, while gelatin, Irish moss, starch, salep, and tragacanth, are used for aqueous and alcoholic bodies, or for insoluble powders.*

In order to obtain perfectly clear and transparent jellies filtration is usually necessary, and gelatin or Irish moss must be used. The other agents give opaque jellies, and do not admit of filtration.

When sugar is added, as is usually the case, it may serve as a vehicle for diffusing insoluble bodies, or such as are incompatible with aqueous fluids, as volatile oils, tinctures, etc.

When flavored with fruit juices less gelatin is needed, as the pectin in the juice gelatinizes when boiled. The "Art of Dispensing" directs these to be made by combining the juice with half its weight of sugar, boiling, skimming and straining.

To 100 parts of the hot juice are now added 2 parts of gelatin, and, after dissolving the latter, the jelly forms on cooling.

CONFECTIONS, JELLIES, ETC.

155.

℞.	Red rose in No. 60 powder	80 Gm.
	Sugar, in fine powder	640 Gm.
	Clarified honey	120 Gm.
	Stronger rose water	160 C.c.

M. Sig. — Confection of rose, U. S. P.

"Rub the red rose with the stronger rose water, previously heated to 65° C. (149° F.), then gradually add the sugar and honey, and beat the whole together until a uniform mass results."

Make one-twentieth the quantity.

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* For proportions needed to jellify see pages 241 and 243.

156.

℞.	Senna, in No. 60 powder	100 Gm.
	Cassia fistula, bruised	160 Gm.
	Tamarind	100 Gm.
	Prune, sliced	70 Gm.
	Fig, bruised	120 Gm.
	Sugar in fine powder	555 Gm.
	Oil of coriander	5 Gm.
	Water, a sufficient quantity to make	1000 Gm.

M. Sig. — Confection of senna, U. S. P.

"Place the cassia fistula, tamarind, prune and fig in a close vessel with five hundred (500) cubic centimeters of water, and digest for three hours by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair sieve, and then through a fine one, or through a muslin cloth. Mix the residue with one hundred and fifty (150) cubic centimeters of water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy mass first obtained. Then, by means of a water-bath dissolve the sugar in the pulpy liquid, and evaporate the whole, in a tared vessel, until it weighs eight hundred and ninety-five (895) grammes. Lastly, add the senna and the oil of coriander, and incorporate them thoroughly with the other ingredients while they are yet warm."

Make one-twentieth the quantity.

157.

℞.	Olei morrhuæ	℥ v
	Ichthyocollæ	ʒ ij
	Sacchari	℥ iss
	Olei amygdalæ amaræ	m. iv
	Olei fimentæ	m. iv
	Olei cinnamomi	m. ij
	Aquæ	℥ iv

M. Sig. — "Cod-Liver Oil Jelly."

Place the oil, isinglass and water in a capsule, heat upon a water-bath until the isinglass melts, then add the sugar, previously triturated with the essential oils, remove from the heat and stir as it thickens. When cold a firm jelly results.

158.

Confectio opii (U. S., 1860).

Opium	ʒ ivss
Aromatic powder	℥ vj
Clarified honey	℥ xiv

M.

159.

Conserva Amygdalarum. (Conserve of Almond.)

Sweet almond	30 Gm.
Powdered acacia	5 Gm.
Powdered sugar	15 Gm.

Blanch the almonds, and incorporate thoroughly with the other ingredients.

(This is a convenient mixture for the quick preparation of emulsion of almond U. S. P., which may be made by triturating the above with enough water to make 500 C.c. It keeps fairly well in closely stoppered bottles, and may be made almost permanent if the almonds are dried at a low heat, after blanching and bruising them.)

160.

℞.	Iodoformi	gr. iij
	Ætheris	℥ j
	Carbon ligni	℥ i
	Glycerini	ad. ℥ iss

Ma. Ft. elect.

Sig. — For Diarrhœa.

Dissolve the iodoform in the ether and mix with the powdered charcoal. Allow ether to evaporate and then make into a paste with glycerin.

161.

℞.	Potassii chloratis	ʒ iv
	Ext. glycyrrhizæ pulv.	ʒ iv
	Pulveris cubebæ	ʒ ij
	Olei gaultheriæ	gtt v
	Confect. rosæ	℥ j
	Glycerini	q. s.

M. Ft. electuarium.

Sig. — Take a piece about the size of a pea.

162.

℞.	Sulphuris	℥ ij
	Potassii bitartratis	℥ j
	Sacchari	℥ j
	Syrupi fusci	q. s.

M. Fiat electuarium.

Sig. — "Sulphur and Cream of Tartar."

163.

℞.	Tinct. ferri chlorid	ʒ ij
	Mucilaginis acaciæ	
	Syrupi	āā ʒ vij
	Tinct. vanillæ	♏ xv

M.

Sig. — "Iron Jelly."

Mix the mucilage, syrup and vanilla and add the tincture of iron. If the mucilage is fresh, the mixture sets into a ruby-red, transparent jelly, but an old mucilage requires a larger proportion of mucilage. This jelly is liquefied by acids.

CHAPTER VII.

PILLS.

The word "pill" comes from the Latin *Pilum* — a ball, and the diminutive **Pilula**, a little ball, is the term used in prescription-writing to denote a pill or pills. A pill may be defined as a mass of medicinal matter, round or ovoid in form, intended for internal administration. A pill should weigh, exclusive of coating, from one to five grains, none being less than one grain unless specially ordered.

A Bolus is a large pill, commonly more than five grains. When very large they are preferably made oval-form. They are more generally prescribed in veterinary practice, and should always be just firm enough to keep their shape without being hard.

Dragees are sugar-coated boli.

Granules are sugar pellets impregnated with medicinal matter which is applied in liquid form and absorbed by the pellets; these are afterward dried. They are restricted mostly to homœopathic practice, and are sometimes called pellets.

Parvules are very small sugar-coated pills, usually containing powerful remedies in small doses, and colored red or pink to distinguish them from granules.

Compressed pills are more properly tablets, and will be treated under that head.

Aggregation pills are made by the gradual accumulation of medicinal ingredients upon a prepared nucleus. They are treated under the head of sugar-coating.

Concentric pills consist of successive layers of medicinal matter, each of which has a different medicinal action from the others, and is separated by a coating of sugar, keratine, etc. They are intended for combinations of drugs, one of which is best absorbed in the stomach and another in the intestines, the latter forming the inner ring or nucleus, and being coated with keratine, salol or collodion, while the outer dissolves in the stomach. They have been also proposed for administering bodies which unite if mixed, as the ingredients of Blaud's pills, the two being separated by a coating of suitable material. They are very troublesome to make and are seldom demanded.

Enteric pills, are pills coated with a substance that will not dissolve in the stomach, but dissolves in the intestines.

THE importance of pill-making in pharmacy is suggested by the popular phrase often used to designate a pharmacist — "a pill-maker."

Not only is the making of pills important, but the knowledge and skill which the pharmacist exhibits in making various pills may commonly be taken as a criterion of his knowledge and skill in general pharmacy.

The operator who treats all pill-masses alike, uses the same excipient and methods in each case, shows a woful lack of knowledge or of judgment, and usually of both. The science of pill-making involves a knowledge of chemistry, materia medica, and pharmaceutical physics, and cannot be thoroughly learned without this knowledge. Skill in manipulation is also necessary, and can only be acquired by practice coupled with judgment.

Study and practice then are the only avenues by which the pharmacist can hope to become master of the art of pill-making.

The object of prescribing medicines in pill-form is two-fold; to cover the taste of disagreeable remedies, and, in some cases, to give them in a concentrated form.

Any medicine which may properly be administered in solid form, and the dose of which is not too bulky, may be prescribed in the form of pills. Many drugs are too bulky to administer in this way, and some, such as the salts of bismuth, cerium, etc., do not have as good a therapeutic action if taken in this form. A few salts, as the bromides of potassium, sodium, etc., have an irritant action, and should always be administered in solution.

Many salts are so easily dissolved as to present special obstacles to the forming of good pills, and many liquids are prescribed in pill-form which render the problem more complex. It is in the ingenuity and judgment displayed in the handling of such special cases, and in the combinations of difficulties that the skill of the operator is best shown.

Special precautions are sometimes to be observed in weighing and mixing the ingredients of pills. Solid extracts should be weighed upon a piece of paper upon which a little lycopodium has been sprinkled and the whole counterpoised. This prevents sticking of the extract to the paper and avoids loss. If the extract be hard or tenacious, unless dry enough to be powdered, it should be softened by trituration with a little water or diluted alcohol (strong alcohol is in most cases not so good for this purpose), taking care to add only enough to make a thick liquid with the extract. This will now be in a condition to mix readily with powders or other extracts. Potent remedies, the alkaloids, active principles, etc., are first mixed with other powders, or if mixed with extracts they may first be dissolved in a few drops of the liquid used to soften the extract to insure complete admixture. Resinous extracts are softened by triturating in a warm mortar or working on a warm plate, which should not be hot.

The ingredients of the pills having been thoroughly mixed, they are next to be formed into a stiff paste or dough for shaping into pills.

This is called a *pill-mass*.

The body added to form the mass is called the *excipient*.

A good pill mass is *plastic*, *adhesive*, but not sticky, and *not easily changed* under ordinary conditions, except by drying.

When well made it is easily moulded and does not adhere to the hands or utensils.

When formed into pills, these should dissolve or crumble when placed in warm water for a few minutes.

The choice of a mortar is important in making a pill-mass. A wedgewood mortar with a broad base, and a small pestle having an extra long and stout handle, should be chosen.

Triturating the mass will be found much less easy and effective than kneading it. By holding the pestle so that the end of the handle rests upon the fleshy portion of the hand near the wrist, the mass can be easily and rapidly worked and nearly the entire weight of the operator imposed upon it without fatigue. The heat generated in working is often an important factor in forming the mass. The warmth of the hands is often well taken advantage of also, by kneading in the hands.

Some operators prefer to use a glass or porcelain slab and a broad and stiff spatula or putty-knife in forming the mass. This has the advantage of forcing more material under the action of the knife at one time and more rapid work may be done upon particular masses, but it has many disadvantages, being restricted in range and more laborious.

An iron plate or griddle well smoothed and polished, is a good adjuvant to the pill utensils, being easily and quickly warmed, and serving an excellent use, when warm, in working resinous or tenacious masses.

The mass should be worked very thoroughly and a free use made of the spatula to keep the mixture under the pestle. The sides of the mortar and pestle should be scraped frequently while the mass is being formed. A stiff spatula is better here than a limber one. The stubs of broken spatulas, the broken and ragged edges being ground off and rounded, are especially useful in pill-making.

The mass being formed, we have next **to divide and shape it** into pills.

It is first taken from the mortar or tile as completely as possible and worked in the hands into a short cylinder, then by means of a broad spatula or wooden roller it is rolled on the tile or pill machine until its length corresponds to the number of divisions upon the tile or machine representing the number of pills we wish to make.

Care must be taken here to keep the "pipe," as it is called, of uniform diameter throughout, and the ends must be squared up frequently by pressing them up with the spatula. This is a very important part of the operation.

The pipe is then placed upon the divisions and cut into sections.

If cut upon a tile, care must be taken to hold the spatula at right angles to the pipe, and to cut all evenly or there will be a difference in the sizes of the pills. The sections of pipe are then rounded roughly in the fingers and finished by rolling under the finisher. In absence of a pill-finisher a large specie cork may be used, or the clean cover of an ointment box, the sides of the cover having been cut down so as not to touch the tile when resting upon the pills.

A duplex finisher is to be preferred to a single finisher, as being better adapted to pills of different sizes.

When rounding the pills in the fingers, they should be pressed, not folded into shape, to avoid showing a crease in the pills. Such creases are difficult to eradicate.

If the pills show a tendency to crumble or show folds when finishing, a smooth surface may be obtained by placing a single drop of water, syrup or diluted alcohol upon a warm tile, and rolling the pills in this under the finisher.

A small, thin, iron plate is very convenient for this purpose, since it can be more easily and quickly warmed than glass or porcelain.

CONSPERGENT OR DUSTING POWDERS.

These are used to prevent the mass from sticking to the machine or to prevent the pills from adhering to each other in the box.

They should be used sparingly in all cases, and particularly when the pills are to be coated.

Many masses can be made into pills without the use of a dusting powder, but most masses require a little.

Lycopodium is most frequently used.

The spores of lycopodium have on the surfaces microscopic ridges or hairy projections which cause the spores to cohere in a manner similar to Burdock burrs, and form a chain-like coating around the pill if it be too moist. Thus a little lycopodium will accomplish as much as a considerable quantity of another absorbent powder and the excess can readily be poured off.

Powdered licorice root is often used. This is a good absorbent and has the advantage of a pleasant taste. The peeled or Russian powdered licorice should be selected for this purpose, being brighter in color and more palatable.

For white pills a white dusting powder is to be preferred. Powdered starch answers well for this purpose. Powdered orris root may also be used, or talcum.

For pills containing odorous ingredients, such as valerianate of zinc, creosote, etc., or such as are particularly nauseous, an aromatic dusting powder is often agreeable. Orris root or cinnamon, or a mixture of these are pleasant additions to the pill-box. Avoid the use of aromatic powders which contain a large proportion of natural oil, such as cardamom, fennel, nutmeg, etc. These are apt to become sticky.

EXCIPIENTS.

The choosing of an excipient is a matter of considerable importance. It is this which determines whether the pills shall be too large or as small as possible, soluble, or so slowly disintegrated as to be of little value, permanent or easily changed by action of the air. It is here that the operator's knowledge of chemistry, materia medica, and physics becomes of practical use.

The excipient should be harmless in its action upon the system, and should not be incompatible with any of the ingredients of the pill. It should have a preservative power upon the mass.

The best excipient is that which most quickly and easily makes a good mass and a small pill which is easily disintegrated.

In many cases a combination of excipients is best in order to obtain small pills, one in order to dissolve the substance and reduce the bulk, the other to impart adhesiveness and plasticity to the mass. This point is often overlooked in the quest for a "universal excipient," which can never be found. Many of these so-called universal excipients will make a plastic mass for a large variety of pills, but they add materially to the size of the pills instead of decreasing them, as can often be done.

Excipients may be divided into three classes, liquid, dry and adhesive excipients.

LIQUID EXCIPIENTS form the most important class and are most frequently used.

They are used for all bodies which are soluble to some extent in the ordinary solvents, including vegetable powders and their extracts, soluble salts, etc. Some of these are soluble in water, and some only in alcohol or oils, etc., and the choice of excipient is controlled by these considerations.

The excipient should have some solvent power upon the solid which is formed into a mass. Thus, we cannot form camphor into pills by use of water because the water has not the solvent power to soften and render adhesive the camphor, but if we use a little castor oil the camphor is partially dissolved, the remainder rendered soft and plastic and the mass can be rolled into pills.

On the other hand, not all good solvents make good excipients. Alcohol and ether are good solvents for camphor, but very poor excipients for it, because they are too volatile, and the solutions are limpid and possess no adhesive properties. A solvent excipient should either be somewhat viscid and sticky of itself, or it should make a solution by action upon the pill-ingredients which will possess enough of these properties to bind the remaining solids in a plastic mass.

Excipients should be added cautiously and well worked in, or the mass may suddenly become too soft. When first added the mass may appear quite dry and crumbling, after a moment's trituration, but on continued kneading the solvent power of the excipient becomes manifest, more liquid is formed than was added in the first place, owing to the fact that a portion of the solid has entered into solution, and a good mass may be formed without further addition of excipient.

It is generally a saving of time and labor, and oftentimes a better mass is secured, by adding all of the required excipient at once, but this plan calls for considerable experience and judgment. The novice who attempts it is almost sure of getting in too much and spoiling his work. Practice will enable one to judge quite closely, particularly in the use of excipients to which one is accustomed. The excipient is best dropped upon the blade of a spatula and transferred to the *end* of the pestle (not the side), from whence it can most easily be distributed through the mass.

A free use of a spatula should be made in keeping the ingredients in the bottom of the mortar and in removing what has caked upon the end of the pestle. The spatula which is used for this purpose should not be dipped into the excipient jar, or this will become contaminated.

The most important of the liquid excipients are glucose, honey, syrup, water, tinctures, alcohol, glycerin, oils, soap and water, treacle and soft extracts.

Glucose, honey (evaporated to half its original bulk), **syrup and water** are adapted for those bodies soluble in water and for many vegetable powders. Sometimes water is used first to partially dissolve and reduce the bulk, then glucose to make the mass.

Glucose or honey is better than syrup, being more viscid and adhesive.

Glucose usually contains a quantity of dextrin, formed during the process of manufacture, which adds to its value as an excipient. It has been improperly called "Syrup of Dextrin."

The commercial glucose is very thick and for most masses is best diluted, when it adds less to the bulk of the pill. A mixture of about four parts of glucose and one part of syrup keeps well and is sufficiently limpid for most purposes.

Honey contains a little wax and gummy matter which makes it more adhesive. It will not make a white pill, however, and possesses no advantage over glucose.

Water is little used alone as an excipient, but is valuable as an aid, as when soap is used, or in some cases with glucose, to obtain a smaller pill than could be made with glucose alone.

Alcohol and alcoholic tinctures are often used with resinous bodies.

When resins of jalap, podophyllum, etc., are prescribed in pills, the respective tinctures of those drugs may be used as an excipient. They possess the advantage over alcohol alone of being more sticky and making a more adhesive mass. Tinctures of powerful drugs, as cannabis indica, nux vomica, etc., should not be used, since even the small amounts needed will add materially to the medicinal activity of the pill.

Alcohol and tinctures, however, are not in special favor as excipients, because they make a tough mass which crumbles unless worked up quickly, and the pills are apt to become very hard.

These qualities may be partially obviated by use of a little glycerin with the alcohol.

Soap is better to use with resinous bodies, although it makes a larger pill. It increases the solubility of the pill and keeps the mass soft.

The water must be added cautiously to these masses, since a very small excess will make the pills so moist that they cannot be handled. The greatest objection to soap is its incompatibility with metallic salts, and with acids.

Glycerin, by reason of its wide solvent power, is much used as an excipient.

Owing to its hygroscopic nature it is little used alone, but is much used in combination with gums or starch.

It prevents the pills from becoming too hard or insoluble, but should not be used when pills are to be gelatin coated.

A good excipient, which serves for quite a wide range of masses, may be made by sifting into glycerin 4 per cent. of powdered tragacanth, and allowing to stand twenty-four hours.

This resembles the official *mucilage of tragacanth,* which is especially valuable as an excipient for salts and insoluble bodies.

Treacle or molasses may be substituted for honey as an excipient, but is not as good and is seldom used.

Sometimes the **tonic extracts** are prescribed as excipients, particularly extract of malt, extract of dandelion and extract of gentian.

These make good masses with many bodies, and are often intended for a therapeutical adjuvant to the pill. They materially increase the size of the pill, and are seldom chosen for excipients when not prescribed by the physician. They are liable to become slightly acid from oxidation of the sugars or albuminous matter, first to alcohol, then to acetic acid. When this has occurred they are unfit for use as excipients for pills containing carbonates, bicarbonates or any body upon which the acid can act.

A strong alcohol is much less liable to oxidize to acid than a weak one, hence this trouble is seldom met with in extracts containing more than 20 per cent of alcohol.

ADHESIVE EXCIPIENTS are required for such bodies as are insoluble in the ordinary solvents and are held in shape solely by the tenacity of the excipient. Such are the salts of bismuth, arsenous acid, reduced iron, mercury, etc.

These present few difficulties, the choice depending mainly upon the relative sizes of the pills obtained. In many cases an excipient which will increase the size of the pills is desirable. It is seldom that a pill is desired smaller than a one half grain quinine pill, and this may be taken as a standard of size for potent remedies or heavy bodies which require to be built up.

Mucilage of tragacanth is the chief excipient of this class.

Tragacanth responds quickly to the action of water and swells enormously, which causes the pills to disintegrate. The mucilage is a thick mass, well adapted to massing dense bodies, and contains enough glycerin to prevent the mass from becoming hard.

Mucilage of acacia, on the contrary, is a liquid which makes a much smaller pill, but the pills will grow so hard in a short time that they are practically insoluble. Acacia dissolves very slowly, and hence pills containing it are less quickly disintegrated, even when glycerin is added. On the whole, the use of acacia or mucilage of acacia as an excipient is not to be commended.

Mucilage of tragacanth or other gums should not be used too freely, because if too much is added, the mass becomes elastic, rubber-like, and the pills cannot be well rounded.

Confection of rose is a favorite excipient with many. This owes its adhesive powers to the sugar and honey which it contains, and possesses no advantage over these. The presence of the rose is objectionable in some cases because of its astringency, or because of possible reactions with the tannic acid which it contains. It should not be used with pills which are laxative in their action, or with those containing iron salts.

Powdered extract of licorice, with glucose, evaporated honey, or other liquid excipient, is often used.

Resin ointment, petrolatum or Canada Balsam, are sometimes used as excipients where aqueous or alcoholic excipients are to be avoided.

These are little used, being confined chiefly to pills of nitrate of silver, permanganate of potassium, or very deliquescent salts.

Most of the so-called "**universal excipients,**" formulas for which are published frequently, belong properly to the adhesive class.

The following are examples of these:

Amylum, 10 G.; Glycerin, 90 G. Rub together in a mortar, then heat to 290° F. until the starch granules are dissolved.

Tragacanth, 4 G.; Glycerin, 96 G. Triturate together, and allow to stand twenty-four hours. (Wiegand.)

Glucose, 120 G.; Glycerin, 30 G.; Powdered Acacia, 6 G.; Benzoic Acid, .065 G.; mix. (Remington.)

DRY OR ABSORBENT EXCIPIENTS.—These are used to stiffen liquid or soft bodies so that they may be formed into a mass.

They are often **the most difficult excipients to select,** especially where comparatively large quantities of liquid are prescribed in pill form. Oftentimes both an absorptive powder, and a liquid excipient must be used in order to obtain a plastic mass and the pills which result are thus enlarged.

Where the liquid can be evaporated this may suffice, but many liquids do not admit of this, and it is often difficult to find a body which will combine with these to make a good pill-mass without forming too large a pill.

Magnesia has the property of absorbing large quantities of some liquids and making a gelatinous mass, and is often used in pills containing large quantities of liquid.

The light magnesia should be used for this purpose — not the heavy. If the light magnesia be mixed with fifteen times its weight of water, and allowed to stand half an hour, it sets to form a jelly which cannot be poured from the vessel. When mixed with some balsams, oleoresins, or volatile oils, it unites with the acids of those bodies to form salts, and usually a small proportion of magnesia is sufficient to make a plastic mass. It acts best when a little water is present with the oil or balsam.

The copaiba mass of the U. S. Pharmacopœia is made in this way — allowing the mass to stand twenty-four hours before rolling into pills. This is done in order to give time for completion of the reaction.

A serious objection to the use of magnesia lies in the fact that if too much be used the mass forms a very hard cement-like body, which is insoluble, and in order to avoid this considerable time is required for the mass to stiffen. When the exact amount of magnesia required is known, the reaction may be hastened by slightly warming, taking care to avoid loss of volatile constituents by too high or too long-continued heating.

Were it not for this tendency in magnesia to form medicinal pebbles instead of pills, when used in excess, it would be a valuable material at the pill counter, but considered in this light it should be used very cautiously, if at all.

Not more than one part of magnesia to ten of liquid should be used in any case.

Soap has a considerable absorptive power for oils and certain chemicals. Animal soap, commonly called **curd soap**, is much better for this than vegetable or castile soap, being harder and more tenacious. Oftentimes a good mass may be made with this without the use of water, either by massing or by digesting. A good creosote pill may be made by digesting equal parts of creosote and curd soap (or a larger proportion of castile soap) in a stoppered, wide-mouth bottle until they combine, then allowing the mass to cool before rolling. This method was recommended by Mr. Martindale, of London. Soap is also useful as an addition to vegetable powder for massing oils, etc.

Crumb of Bread (*Mica Panis*) is an excellent absorbent for oils, and has for many years been recommended for use as an excipient.

It serves fairly well for pills, but is seldom at hand in a fresh condition in the pharmacies, and does not possess sufficient advantages over other excipients to be sought avidiously. It does not make a very adhesive mass and has mostly passed into disuse.

It is best used when one day old.

Flour, either wheat or rye flour, makes a good substitute for crumb of bread when used in connection with aqueous fluids. The gluten makes plastic dough, the absorbent powers of which are interestingly shown at the Waltham watch factory, where dough is used to remove the excess of oil from the minute-screws by which the watch-works are held together, a little trick which, though simple, has been the means of saving many thousands of dollars to the company. It removes the excess of oil thoroughly, yet leaves them lubricated and in a condition to resist rust. Flour may often be substituted for starch as an excipient, with advantage.

Powdered licorice root is one of the best inert drying powders, and is largely used. The greatest objection to it is that too much may be required, so that the pills are unduly large. With small amounts of liquids it may be used in nearly all cases.

Powdered Extract of Licorice is particularly useful in connection with powdered licorice root.

The commercial article contains a large quantity of starchy and other insoluble material (commonly 35 to 40 per cent.) which is absorptive, and a better mass may be secured than when the powdered root is used alone.

Ordinarily about half as much of the powdered extract is used as of the root.

Tragacanth has a strong affinity for aqueous liquids, but is not of so much value with oils or balsams unless a little water be added also. Tragacanth consists of a small proportion of a soluble gum, and large proportion of Bassorin, a peculiar gummy body which swells enormously in water, but does not dissolve. It is this body which gives to tragacanth its sponge-like property, but it responds only to aqueous solvents.

Acacia is sometimes substituted for tragacanth in order to bind a mass together, but is more objectionable, unless mixed with glycerin to prevent the pills from becoming insoluble.

Powdered Althæa is an excellent form of gummy excipient to use. This consists chiefly of gum and starch, and does not harden as acacia or tragacanth alone do.

It is much used in some sections.

Precipitated Phosphate of Calcium is the best of the inorganic powders, except magnesia. Its usefulness in this respect is limited, and it is employed rather as a diluent.

It is almost insoluble in neutral liquids, and has little or no medicinal action when taken into the system in the solid form.

Manna is seldom used. It is useful as a protective, owing to its saccharine character. It may be used advantageously with salts containing water of crystallization which have a tendency to liquefy when triturated, or in those in which water is set free by chemical reaction, as in the Blaud's pills, etc.

Manna not only takes up the water, but protects the salt, and makes a fairly good mass.

Cacao Butter may be used for pills containing much oil or soft resin. The oil is usually added to the melted butter, stirred in thoroughly, and the mixture chilled until it stiffens.

The quantity of oil which can thus be incorporated is limited only by the consistence of the mass so obtained. Pills made of cacao butter cannot be handled much, and should be kept in a cool place.

Wax will absorb much more oil, and the pills made from it are more permanent.

The yellow wax is better to use, since the white contains small quantities of foreign fats which are liable to become rancid, and it has a greater tendency to crumble.

Objections are made to wax that even when mixed with a considerable proportion of oil, the fusing-point of the mixture is above the heat of the body, and the mass is insoluble in the stomach, consequently the pill will pass through the system without disintegrating.

It is claimed, however, that if the wax be first mixed with starch this will not occur, and a mixture is recommended as a stock-excipient of equal parts of wax and starch, or flour. In making it the wax should first be obtained in thin shavings, dried for a few days in a warm place, then triturated lightly in a cold mortar.

It is important that the mortar be well chilled, and kept so by being placed in a basin of ice water.

Creosote, carbolic acid, volatile oils, balsams, oleo-resins, etc., can now be incorporated with this base and rolled into pills.

This mixture of powdered wax and starch is rather difficult to make, and the same result may be obtained by melting the wax, then adding half its weight in flour or *licorice root*, and *half* the balsam or oil, then when nearly cold incorporating the remainder of the balsam (or oil). Balsams and liquid oleo-resins usually require about one-third their weight of wax (together with the flour or licorice root), and oils and other similar bodies require one-half to two-thirds their weight in wax in order to form a good mass. Much depends upon the consistency of the oil or balsam, in determining the proportions to be used.

CLASSIFICATION OF PILLS.

The following classification of pills according to their ingredients is a modification of that made some years ago by Mr. Joseph Ince, Lecturer on Pharmacy at the School of Pharmacy of the Pharmaceutical Society of Great Britain.

The classification is made for the purpose of discussing special difficulties and the best excipients for each class, but it should be borne in mind that the excipients mentioned are but for that class only, and that combinations of ingredients from the different classes call for the exercise of judgment in order to select the best for the combination at hand.

CLASS I. — POWDERED DRUGS AND VEGETABLE EXTRACTS.

These offer very few difficulties, and with most of them any of the liquid incipients will make a good mass, since most vegetable powders are adhesive when wet. If the drug is of a resinous or oily nature, soap or an alcoholic tincture of the drug, or glycerin, are to be preferred. In all cases it should be remembered that powdered drugs *absorb moisture slowly*, and time is required to obtain a satisfactory mass. The mass may be made quite soft at first, and will stiffen as the pills are being rolled. If the mass be too hard the pills are liable to crumble and require remassing.

The same applies to extracts, but in a less degree. Since extracts are required to be of a "pilular consistence" they are sometimes ready to be rolled immediately, but more often they are either too hard, and require to be softened with alcohol or water, or are too soft and may be evaporated on a hot plate, or stiffened by incorporating powdered licorice, etc.

Sometimes a little gum becomes necessary, when althæa or tragacanth are to be preferred.

Aqueous extracts are sometimes found in a condition of partial fermentation, acetic acid and carbonic acid gas being slowly formed. Such require to be evaporated on a hot tile, before being incorporated into pills, lest the pills afterward fall apart from pressure of the gas or reaction of acid with other ingredients. The heat stops the fermentation and drives out all of the gas. These extracts (and ten of the official solid extracts are aqueous) should never be used in pills containing carbonates, unless first tested and proved to be free from acid. The acetic extracts should also be avoided in such pills.

CLASS II. — ALOES, RESINS, AND GUM-RESINS.

This class would include all inspissated juices, as opium, etc., and non-oleaginous exudations. They are all solid but non-fibrous bodies, largely soluble in mixtures of alcohol and water, and make small, easily soluble pills.

Soap and water head the list of excipients for these, about one part of soap to six to twelve parts of drug being required according to its character. Soap increases the solubility of resinous bodies and the mass remains soft. Solution of potassa was formerly used to a considerable extent with these, forming a soap with the resin, but the medicinal properties are somewhat altered by such treatment, and its use is now universally condemned.

Compound decoction of aloes, with or without soap, is a favorite excipient in England for this class, and makes an excellent mass. Liniment of soap or of soft soap might serve in that capacity when the odors of rosemary or lavender are not objectionable.

When soap is incompatible with other ingredients, glycerin, mucilage of tragacanth, oil, or glucose, may form a good mass.

Alcohol makes a tough mass which hardens rapidly.

The powdered gum-resins should never be used. The whole gum-resins are easiest powdered in small quantities by thoroughly chilling and rubbing in a *cold* mortar.

CLASS III. — OILS, OLEO-RESINS, AND HYDROCARBONS.

This class includes the liquid balsams, and all liquid bodies which do not admit of evaporation, and therefore require to be solidified by absorption, or in some other manner. They are the most troublesome of all the pill ingredients to form into *small* pills. Were the size of the resulting pills of no importance they could be easily managed, but the inexorable rule to "make the smallest pill possible" (down to one half grain), demands, oftentimes, seeming impossibilities. The selection of the excipient which will yield the smallest pill, together with a proper mass, is no light task. Thin liquids are more troublesome than viscid, and volatile oils more than fixed.

Magnesia is the most efficient excipient and the most objectionable, and should never be used except as a last resort. When used, time should be allowed for it to set, and this may be hastened by applying a little heat.

Failure sometimes results with it, owing to the fact that no aqueous moisture is present, and it is always safe to sprinkle a few drops of water upon it before incorporating with the oil or other liquid.

It has been claimed that lanolin will prevent a magnesia mass from becoming very hard, if used to the extent of $\frac{1}{12}$ the total weight of the mass.

Wax comes next in efficiency, and is less objectionable, particularly when used in combination with starch or some vegetable powder.

From half to an equal weight of wax is needed for oils and other fluids, according to the viscosity.

Sometimes a little tragacanth or extract of licorice is needed to make the mass more adhesive.

The mixture of wax and flour, with which the liquid may be incorporated by trituration, usually makes a good mass. When the mass is made by mixing the liquid with melted wax, it is well to chill the mixture afterward, remembering that a freshly congealed fat or wax is never as firm as one which has stood for some time in a cool place. It is well also to add only half the liquid to the melted wax at first, and after incorporating this the remainder may be incorporated also. In this way lumping, caused by the too sudden cooling of the wax is avoided. Such lumps are hard to eradicate.

Cacao butter has been recommended as a substitute for wax, but pills made with it must be kept in a cool place.

The trouble with employing wax or cacao butter for extemporaneous preparations of pills is that time is required for the mixture to set, and if the wax is used in small proportions, unless several hours can be allowed for the mixture to stiffen, the pills are likely to be too hard to disintegrate in the stomach. The mixture of wax and oil should be chilled, as in suppository-making, before the mass is made up, to avoid this.

Thin and mobile fluids do not mass as well with these as viscid bodies, and with thin liquids a smaller pill may be made by use of flour or althæa and syrup, than with wax.

Soap makes an excellent excipient for the fixed oils and balsams or oleoresins, but is less efficient with volatile oils and the hydrocarbons. When used in a mass containing an oil and solid bodies, it should be first mixed with the oil alone, then this mixture added to the other ingredients.

When added to the entire mass the results are not as good. In all masses containing both liquids and solids, the first aim should be to get the liquid into suitable condition, and while allowing for the absorptive or solidifying powers of the other ingredients, the attention is first devoted to the massing of the liquid.

Absorbent powders are often preferred when so much is not required as to make an unduly large pill. A mixture of two parts of licorice root with one of licorice extract has considerable binding as well as absorptive powers. This makes a good mass where not more than one minim of liquid is to be contained in a pill. Sometimes other vegetable powders are used when they agree with the medicinal action of the pills. Flour and althæa are the best of the white absorbent powders. Kaolin is also good. All of these require some aqueous fluid to develop their adhesiveness, which should be added.

An ingenious method for making liquid bodies into pills has been proposed by Mr. William Kerchumann, who suggests to make first an emulsion with acacia, to which is added magnesia, and after standing twelve hours borax is added to coagulate the gum and make a mass.

This is interesting from the principles which it involves, but is open to the usual objections to magnesia and alkalies as excipients.

Another method which is particularly convenient for massing volatile oils, etc., which are frequently ordered in pill form, is to keep in stock a jelly containing a definite proportion of oil, and making the mass from this with licorice or althæa.

A paste made from 5.5 parts of gelatin, 2.5 parts of sugar and 12 parts of water, will gelatinize an equal weight (20 parts) of creosote, carbolic acid or an oil, and if preserved in a bottle covered with a layer of diluted alcohol, will keep almost indefinitely. Two parts of this jelly are used for each part of oil or creosote ordered, and a mass is quickly made by incorporating a sufficient quantity of licorice or althæa powder.

CLASS IV. — CHEMICAL BODIES.

These are of two kinds, the organic chemicals and the inorganic. They require much judgment and a knowledge of chemical reactions and compatibilities. When crystalline bodies are to be incorporated in pills, they should first be finely powdered, and in case of powerful remedies it is advantageous to dissolve them in water or glycerin, and add this solution to the mixture, taking care that no more liquid is used than will make a good mass.

In this way the crystalline structure is destroyed, and the potent remedy thoroughly diffused through the mass with a minimum of labor.

The oxidizing agents, as permanganate of potassium, silver salts and the salts of mercury, require special precautions, which are treated under their separate heads.

ORGANIC CHEMICALS.—The most important of these in pill-making are the alkaloids.

When **the powerful alkaloids** are to be massed, such as strychnine, atropine, etc., special care should be exercised in weighing and mixing them. The safest and quickest way of mixing them is either to add them to the other ingredients in solution, as already suggested, or to mix first with an equal bulk of another powdered ingredient, which mixture is then diluted with the remainder, gradually added, so that a uniform admixture is assured. Pills containing these should be made to weigh about one-half grain each, some inert body like starch or licorice being used as a diluent when needed.

Quinine pills are perhaps the most common of the alkaloidal pills, the sulphate being generally used. No difficulty is found in massing quinine with the usual liquid excipients, glucose, glycerin, mucilage or glycerite of tragacanth, etc., all giving a plastic and adhesive mass. If a white pill is desired, only a white or colorless excipient may be used, and the most scrupulous cleanliness observed, both with the hands and the utensils. Even then a very free use of starch as a dusting powder is usually necessary.

The use of acids as excipients for these has often been suggested, the purpose being to obtain smaller pills. Tartaric acid, in the proportion of one grain to six to ten grains of the quinine, citric acid in about the same proportions, lactic acid and dilute mineral acids in quantities sufficient to mass, are usually recommended. These all make a mass which is very plastic and easy to work at first, but which loses its plasticity very rapidly and becomes hard and immobile.

Rapid work is required, both in massing and rolling these, in order to finish the pills before the mass has set.

Synthetic Remedies. — These are mostly organic, and include such bodies as antipyrine, acetanilid, salol, etc.

The choice of an excipient for these depends almost entirely upon their solubilities.

Those soluble in water may be massed with glucose, mucilage or glycerite of tragacanth, honey, etc. These would also make a good mass with many which are very slightly soluble in water.

Such as are insoluble in water may be massed with glycerin, or a viscid oil, either with or without soap — preferably with.

The adhesive excipients may also be used with these, but will make a larger pill, in most cases.

Camphor, Phenol, Thymol, Chloral, etc. — These make little trouble when massed alone, but when mixed together or with resinous bodies they partially or completely liquefy. When this takes place, the liquid is best absorbed by means of flour or licorice, and massed with syrup or glucose.

When partial liquefaction occurs, the mass may often be made by simply beating the ingredients together in a warm mortar, without the use of any incipient. In such cases alcohol or ether should not be used to powder the camphor, lest the mass be too soft.

If it is necessary to powder the camphor a little chloroform may be used, and then after triturating the camphor to a powder the latter should be thoroughly dried before mixing with the other ingredients.

Soap with oil or water makes a good excipient for these when needed. Carbolic acid, chloral, etc., may also be massed with althæa and glucose, or licorice and mucilage of tragacanth.

Other organic bodies are treated according to their general characteristics. Organic acids mass well with glycerin, but when the acid is very soluble in the glycerin, as tannic acid, the pills must be finished quickly, because the mass soon hardens.

Glycerin forms a good general excipient for many organic bodies.

INORGANIC CHEMICALS. — Iron and mercury and their salts are most frequently prescribed in pills, but certain salts of potassium and silver are also used, and occasionally the salts of the other metals. Most salts require the addition of a vegetable powder to make an adhesive mass, and in the case of hygroscopic or deliquescent salts, to also absorb the moisture in the excipient and air, which would otherwise soften or liquefy the salts on standing. Powdered licorice-root or extract, or althæa are best to use for this purpose in the absence of any other vegetable constituents of a mass. Sugar is employed in the iron pills, and acts both as a binding and a protecting agent.

Very deliquescent salts, like potassium acetate, require to be massed with a moisture-repelling excipient. Canada balsam, cacao butter, resin cerate, or hard petrolatum answer well for this purpose.

If the salts are crystalline they should first be very finely powdered, then mixed with the vegetable powder or with extracts.

Glycerin should not be used for massing metallic oxides or basic salts, because it forms a hard, stone-like cement with many of these. In general, glycerin is a poor excipient for metallic salts or bodies, though it may be used in some cases.

Soap is incompatible with all the metallic salts except the salts of potassium and sodium, forming insoluble metallic soaps, hence it should never be used in masses containing these.

Iron and Iron Salts are much used in pill-form, and offer some peculiar difficulties. There are three classes of these: (*a*) Those containing metallic iron or ferrous salts; (*b*) Those in which a reaction occurs in making the mass; (*c*) Those which contain ferric salts.

(*a*) When metallic iron, as reduced or "alcoholized" iron, is made into pills a good binding agent is needed, and since this is a heavy powder a bulky excipient is often to be preferred. Extract of licorice (one to ten) and glucose, or manna and syrup, make an excellent mass. Confection of rose or mucilage of tragacanth are also good excipients.

When **ferrous sulphate** is to be made into pills the dried salt, Ferri Sulphas Exsiccatus, U. S. P., may be used. This makes a better and less changeable mass than the crystals.

If the crystals are ordered, the dried salt may be substituted in the proportion of three grains of dried sulphate for each five grains of the crystals. This should not be done, however, if the pills belong to class *b*.

Ferrous sulphate may be massed in the same manner as reduced iron.

(*b*) **Ferrous carbonate** is a very desirable form of iron, but cannot be kept in a dry condition, unless protected, and hence is obtained for pills by a reaction which takes place between crystallized ferrous sulphate and sodium or potassium carbonate in making the mass.

In making masses of this character only the best materials should be used, since a ferrous sulphate which is slightly oxidized will not yield a bright-green ferrous carbonate, and the mass should be exposed to the air as little as possible to prevent oxidation after the carbonate is formed. When these precautions are taken a bright-green mass, the color of true ferrous carbonate, results, but with an impure ferrous sulphate, or with an undue exposure to air, the mass is darker, and may be almost black. Exposure to light is beneficial.

Two forms of this are official — Vallet's mass, massa ferri carbonatis, and Blaud's pills, pilula ferri carbonatis — the difference between the two being that in the first case the alkaline sulphate, which is formed by the reaction, is removed by washing, while in the second case it remains as an ingredient of the pills.

In making Vallet's mass, solutions of ferrous sulphate and sodium carbonate are mixed while hot, and the resulting precipitate of ferrous carbonate is washed with distilled water, which has been boiled to expel all dissolved air and mixed with syrup to further protect the precipitate from change, until the sodium sulphate is removed, then the precipitate is quickly drained in a covered funnel and added to a mixture of honey and sugar and evaporated to a pilular consistence. It is during this draining and evaporation that the greatest change takes place, and great care is required to obtain a greenish mass, — it often becoming black.

The process is rendered easier if the salts are mixed while the solutions are hot, in order to get a more dense precipitate, which is then washed by a hot saccharine solution instead of cold, and finally the drained precipitate mixed with the sugar and added to the honey which has previously been evaporated to half or two-thirds its original bulk. By this means the evaporation of the mass is much hastened and the salt is exposed much less.

In the Blaud's pill, crystallized sulphate of iron is used because this dissolves much more quickly and consequently reacts more promptly than the dried sulphate. The mass is made ~~by~~ moistening the ~~potassium carbonate with glycerin and~~ water, then adding the ferrous sulphate mixed with sugar, which is used to protect the ferrous carbonate which is formed, and beating into a mass, which rapidly becomes a deep green. The tragacanth and althæa are then incorporated and the mass divided into pills. During the reaction water is liberated from the ferrous sulphate, which aids the reaction and also softens the mass, and it will be found that if the full quantity of water and glycerin which the Pharmacopœia directs are added to the potassium carbonate the final mass will be soft and must be set aside for a short time to stiffen. Four-fifths of the liquids (or 8 drops each instead of 10) will yield a good mass in many cases. Potassium bicarbonate should never be used in making these or similar pills, because carbonic acid gas will be given off during the reaction, causing the mass to swell. The mass must then be allowed to stand for some time until the reaction is complete, making an undue exposure, or if rolled into pills quickly these are liable to be forced apart by the escaping gas.

Pills of iodide of iron are another instance of a reactionary mass, the iodide of iron in this case being formed by direct union of reduced iron and iodine in contact with water. An excess of iron is used because the salt is less easily decomposed or changed in the presence of metallic iron, and sugar is also added as a further protective. The mass (the other ingredients having been added) is then evaporated on a water-bath, with constant stirring, and finally divided into pills which are then varnished with tolu to prevent all access of air. It is much easier to get a satisfactory mass of iodide of iron than one of carbonate of iron, regarding the final condition of the ferrous salt.

The finished pills each contain a trifle less than one grain of ferrous iodide and one-half grain of reduced iron.

(*c*) **The Ferric salts** which are used in pills are mostly the oxide, hydrated oxide, soluble oxide, or the scale salts, as the citrate, phosphate, etc. The oxide and hydrated oxide are seldom used and present no difficulties, requiring simply an adhesive excipient.

The soluble oxide (saccharated oxide of iron or Eisenzucker) and the scale salts are quite soluble and care must be taken not to add too much excipient. It should be remembered that there are two forms of citrate of iron, one designed for pills, which is very soluble, but slowly so, and the ammonio-citrate or " soluble citrate," which is quickly soluble.

The latter is not well adapted to massing, though a good pill can be made from it with glucose or syrup if used cautiously. A single grain too much of excipient in a small mass will, however, change a firm mass into a semi-liquid paste. Similar results will follow in massing the soluble oxide and the citrate of iron if too much excipient be used, though not as easily. Masses made with aqueous excipients are also hygroscopic, and require to be kept from contact with the air either by coating or by storing the pills in tight containers, with an excess of licorice powder, etc.

For these reasons the fatty excipients, as petrolatum, simple ointment, Canada balsam, cacao butter, etc., are recommended for making these pills, a slight excess having no solvent action upon the salt and therefore doing no harm, and the pills are not hygroscopic. These excipients do not make as firm and plastic a mass as glucose, mucilage of tragacanth, etc., but are otherwise unobjectionable.

Mercury and Mercury Salts. — Pills containing metallic mercury are made by first emulsifying the mercury with some viscid body in order to finely subdivide it, a mixture of honey of rose and glycerin being used in the official process. The dense emulsion is then stiffened into a mass by incorporating inert powders, licorice and althæa being used for that purpose. This forms an excellent mass, but it must not be triturated or worked very much or the mercury will separate and collect on the surface in little globules which cannot be reincorporated. The same is true of other preparations containing finely divided mercury, as mercury with chalk, a good mass may be obtained by use of mucilage of tragacanth, but the mass must not be worked any more than is really necessary lest the mercury separate.

Mass of mercury (blue mass) is often incorporated with other cathartics and extracts.

It is best triturated first with the dry powders, then excipient (glucose, honey or glycerin) is added and the mass rolled. The mercury is more liable to separate from a mass than from dry powders.

Mercury salts need to be handled very carefully in order to avoid reduction. Contact with metals, even as slight as in the use of a steel spatula or the cutting of the mass upon the brass plates of a pill-machine, is sufficient to reduce many of the salts of mercury when moist; consequently these should not be used for masses containing mercury salts. The mass should be worked in a wedgewood mortar, using a horn or rubber spatula, and the pipe cut upon a rubber machine or pill-tile.

An illustration of the ease with which mercury salts are reduced occurred in a manufacturing establishment a few years ago, when calomel pills, made with starch and glucose as excipients, unaccountably lost their bright, white appearance and became gray. Acting upon the supposition that this was due to carelessness in working or handling the mass, another lot of several thousand was made, using great care in selecting the materials and working the mass. These darkened in the same manner after standing a few days. An investigation was then made, and the trouble found due to minute traces of iron in the starch from the iron mills in which it was ground. · Starch ground in burr-stone mills was obtained, and calomel pills made with this remained white.

Some of the mercury salts are also reduced by rubbing, particularly when dry, and it is always wise to moisten them with a little water or excipient before incorporating them with intractable bodies, to avoid any possibility of reduction. If they are to be mixed with a powder, as starch, licorice, etc., the moistening is unnecessary, but the powders should be triturated very lightly.

Probably the best excipient for these pills when they are to be dispensed without coating, is that proposed by Mr. Thomas Wiegand, — a glycerite of tragacanth, made by triturating 4 gm. of powdered tragacanth with 96 gm. of glycerin, and allowing to stand over night.

In place of this, glycerite or mucilage of tragacanth may be used. Glucose is said to reduce pills of calomel, but probably much depends upon the glucose in question, since pills made with this have shown no sign of change on keeping. Manna has been highly recommended for massing these, and may be used without the addition of a vegetable powder.

Phosphorus Pills. — When phosphorus is to be incorporated in pills, it should always be added to vegetable powders in solution.

The best solvents for this purpose are chloroform and carbon disulphide. Special precautions must be observed in weighing the phosphorus, since it begins to oxidize as soon as it is exposed to the air, if dry. It should be weighed under water, and care be taken that water is not weighed as phosphorus nor phosphorus as water. In order to avoid these errors, a capsule or watch-glass containing a little water is first counterpoised upon the balance; then a piece of phosphorus of the judged size (which has been cut under water in another dish, then dried by pressing in dry filter-paper) is dropped into it and weighed. If too heavy, it is removed from the water, the capsule and its contents again counterpoised (for in taking out the bit of phosphorus enough weighed water will have been removed to make a serious error in the ultimate weight of phosphorus, unless corrected), then a smaller piece is dried, dropped into the water and weighed as before. This operation must be repeated until the desired weight of phosphorus is obtained.

The weighed phosphorus must then be thoroughly dried with filter-paper or absorbent cotton, before dropping into the solvent, for a little moisture may hinder solution.

The solution should always be made in a small (homœopathic) vial or test-tube, selecting one, if possible, which will just hold the liquid without leaving much air space.

If free contact of air is allowed while the solution is taking place, part of the solvent may be lost; and what is worse, the phosphorus will be partially oxidized, and then a clear solution cannot be obtained.

This will also occur if the liquid be violently agitated in a vial or tube which it only half fills.

The solution having been obtained, it is then poured upon the dry powder in the mortar, stirred lightly to moisten the powder evenly, and also to favor evaporation, but avoiding the spreading of the paste about the sides of the mortar; and when the liquid has nearly evaporated and fumes begin to come off, the liquid excipient (glycerin, glucose, syrup, etc.) should be added and incorporated as quickly as possible. All the liquid excipient should be added at once when the amount needed is known. The aqueous excipient will prevent further oxidation of the phosphorus, but the pills should be coated with tolu as soon as finished.

When phosphorus is prescribed alone in pills, licorice, althæa, flour, starch, or any inert powder may be used for distributing the solution upon. When other powders enter into the composition of the pill these will serve the same purpose, extracts or fluids being added last.

Phosphorus pills have been made by dissolving the phosphorus in hot cacao butter, and when the fat has solidified, rolling it into pills. They are then dusted with desiccated chocolate and sugar to cover the odor and taste. Wax and resin have also been used in a similar way.

The *British Pharmacopœia* directs a phosphorus mass to be made by triturating 3 grains of phosphorus with 120 grains of tolu balsam under hot water until no particles of phosphorus are visible. Then 57 grains of wax are added and thoroughly incorporated, also under water.

The water must be kept hot enough (60° C. or above) to melt the phosphorus and thoroughly soften the balsam and the wax, and the mass so made is stored under cold water. When dispensed every two grains, representing $\frac{1}{30}$ grain of phosphorus, are incorporated with one grain of powdered curd soap, a little alcohol being used if necessary to obtain a plastic mass, then rolled into pills.

Silver Salts. — These are all reduced by contact with vegetable matter, and form an exception to the general rule that inorganic salts should be mixed with a vegetable powder.

To do so with the salts of silver would result in a complete reduction of the salt. This is also brought about by the ordinary excipients, and these too should be avoided.

Since the salts of silver are heavy bodies and are given only in small doses, some diluent is necessary, and an inert inorganic body should be chosen. Kaolin (china clay), talcum, or Fuller's earth are best for these.

A mixture of silver oxide or nitrate with kaolin or Fuller's earth masses well with water, but the pills are apt to crumble when they become dry. Coating with tolu retards this.

A better mass is obtained with hard petrolatum (or a mixture of petrolatum and paraffin about the consistence of ointment) or resin cerate.

These are organic bodies, but having no solvent action upon the silver salts, the latter are only slightly reduced, particularly by petrolatum. Pills made in this way have shown scarcely any change of the silver salt after keeping several years.

Anhydrous sodium sulphate and kaolin, in the proportion of one part of the dried sodium sulphate to two of kaolin, massed with one of water has also been recommended for such pills. The silver salt is mixed with this and then made into a mass which must be rolled quickly, as it soon becomes brittle.

The water enables the sodium salt to crystallize, and it sets into a hard strong mass like plaster-of-Paris, which is readily soluble in water. The mass remains plastic only about 5 to 10 minutes, and must be worked before it begins to harden.

Occasionally silver nitrate or oxide is ordered combined with an organic body in pills, as pills of silver oxide and creosote. If these are mixed directly an explosion (in this case) will occur. The only way to prevent this is to make a small mass of the silver oxide with kaolin and petrolatum, also a mass of creosote with wax, flour and water, then mix the two masses and roll. Even then a reaction is liable to ensue.

Potassium permanganate reacts with organic matter and is reduced, consequently it should always be massed with clay or talcum and petrolatum and rolled on a glass tile or rubber pill-machine. All that has been said regarding the massing of silver salts applies to this also. The best excipient is kaolin and hard petrolatum.

Other Salts. — Occasionally some of the salts of arsenic, bismuth, calcium, copper, lead, potassium, sodium, zinc, etc., are ordered in pill-form. These offer no difficulties beyond the special ones already mentioned under the general head of inorganic chemicals.

It should be borne in mind that salts of bismuth and copper are reduced by prolonged contact with iron, and these should not be massed in an iron mortar, nor with a steel spatula upon a tile. The soluble salts may be mixed with licorice, althæa, etc., and massed with glucose, and the insoluble salts are massed with extract of licorice or mucilage of tragacanth.

This latter contains some glycerin, but not enough to exercise a very decided solvent action.

PILL COATINGS.

Pills are coated to cover the taste, to prevent change by excluding air, and to render them more slowly soluble, or even insoluble in the stomach. In the latter case the pills are intended to pass through the stomach entire and dissolve in the intestines.

The coating of pills is an art which demands considerable practice, and the knack for which is less readily acquired than for most pharmaceutical operations.

The pills must be made firm and the use of hygroscopic excipients should be avoided. The latter are apt to attract moisture from the coating and cause it to crack. When gelatin is used over a glycerin excipient the coating is likely to soften.

On the other hand, the pills should be dry enough, so that moisture will not exude and the coating become softened or dissolved. It is customary for the manufacturers to dry the pills in a warm place for a few hours before coating.

The surface of the pill is thus hardened while the interior still remains soft.

Coated pills are almost always more slowly soluble than uncoated, but the solubility should not be hindered to any great extent.

Dusting powder should be thoroughly removed before coating, particularly when a transparent coating is to be applied.

This is best done before the pills are made, *i. e.*, by making the mass so firm that no conspergent is needed. If necessary to use it, licorice is commonly better than lycopodium, as it colors the pills more evenly.

It may be removed by shaking the pills in a sieve. If the surface of the pills still presents a variegated appearance, do not apply the coating at once, but either remove all of the objectionable powder with a brush, or cover it and the pills with a little moist lamp-black (or starch), so that the color will be uniform when coated. If an opaque coating is to be applied, this is not necessary.

Varnishing is the term sometimes applied to coating with resinous or balsamic substances, as tolu, mastic and the like. The ordinary varnish, such as is used for wood-work, is never used, but an ethereal solution of tolu, etc., constitutes the varnishing agent.

These coatings are specially adapted for dispensing exigencies, and are often directed for pills which are liable to change on exposure to air. The Pharmacopœia directs tolu coating to be used on the phosphorus and iodide of iron pills as a protective.

An old tolu, which has lost much of its oil and become brittle, is better for this than a fresh balsam.

The resinous remainder of tolu which has been used in making syrup of tolu by the former (1880) official process, or tolu which has been well washed in hot water, may be used in place of fresh tolu.

The tolu having been dissolved in ether, a few drops are placed in a capsule and the pills rotated in this until uniformly coated and the ether has evaporated.

If a strong solution is employed, as directed by the Pharmacopœia, only a few drops of solution should be used at a time, commonly about half as many drops of solution as there are pills to be coated.

Novices are prone to use a large quantity of the solution, whereby the pills are wetted more quickly, but on evaporation of the ether the pills will become sticky and adhere to everything they touch. If this occurs the best treatment, after separation of the pills, is to place the capsule on ice in order to harden the coating. It can be obviated by using only a few drops of the solution at a time, and repeating the operation until a sufficient coating has been obtained, or by using a very dilute ethereal solution. A thick coating must not be expected, only enough being needed to form a thin film of resin around the pill.

A still better way of applying the coating is to spray the solution upon the pills from an atomizer, keeping the pills constantly in motion.

Combinations of tolu with other bodies are used, as tolu and sandarac, tolu and mastic, etc. These make a harder coating than tolu alone, and are also more easily applied.

Three parts of tolu and seven parts of mastic or sandarac dissolved in ether or absolute alcohol make a good solution. Ether volatilizes more quickly than alcohol and is preferable on that account.

When the pills are to be double coated, and sugar or gold leaf is to cover the varnish, special treatment may be required to enable the second coating to adhere to the resinous.

If sugar is to be applied by intervention of mucilage the gum will not adhere to the resin unless the latter be first moistened with a little weak solution of potassa, whereby the resinous coating is partially saponified. When heat is used, this is unnecessary.

SUGAR AND PEARL COATING. — Sugar coating has been replaced to a large extent by gelatin coating, but it is still applied to a great number of pills. It requires more practice to obtain satisfactory results upon a small scale than other coatings, and the best results can only be obtained by operating upon a quantity of pills and by means of expensive apparatus. Sugar alone is never used for coating, being too translucent, but is mixed with some fine, insoluble, white powder, as starch, arrow-root, talcum, etc.

A good mixture for use at the dispensing counter is milk sugar, 6 parts; starch, 1 part; and powdered acacia, 1 part. To coat pills with this, moisten them first with a little water or syrup, and place in a round box or coating-sphere with some of the coating mixture, using about a teaspoonful of the mixture to each dozen pills. Roll the pills thoroughly in the powder, then transfer them to a clean box or sphere and polish them by attrition. If the first coating is not heavy enough the process must be repeated.

On the large scale the pills are not moistened, but, having been partially dried, are placed in a pear-shaped vessel made of copper, which is mounted on the end of an oblique shaft, and is surrounded by a steam coil or jacket so that the vessel may be heated.

The necessary quantity of sugar mixture is then added, and the closed vessel is made to revolve. Steam is now turned on, and the vessel is heated just enough to partially melt the sugar and make it sticky.

When the coating has been evenly distributed over the pills the steam is shut off and the revolving continued until the pills are polished and the coating is hard. A smooth, glossy coating of any desired thickness is obtained in this way, which is impossible by hand methods.

It is possible to make pills in a similar manner by using medicinal agents in place of the sugar mixture. A minute pill or nucleus is first made in the usual way, say of quinine, then these nuclei are placed in the coating apparatus and coated with quinine until a pill of the desired size is obtained.

Such are called *aggregation pills.*

These may afterward be coated with gelatin or sugar, etc. Such a process is of questionable value when medicinal agents which are injured by heat are so treated, but has the advantage of yielding a pill which is easily disintegrated.

Pearl coating is similar to sugar coating, but contains a large proportion of powdered soapstone or talcum, so that the pills have a pearly appearance.

Sometimes talcum alone is used. The coating is applied in the same manner as sugar coating.

In moistening the pills with mucilage do not apply enough to give them a wet and shiny appearance; only two or three drops of liquid are necessary for each dozen of pills. The easiest way of applying it is by spraying from an atomizer. If the gum is mixed with the coating powder the pills are readily moistened in a sieve by holding them for a moment in the steam arising from boiling water.

Egg albumin and gelatin are also used for moistening previously to rolling in the powder. The former is easily applied and gives good results, being prevented from subsequent change by the preservative powers of the sugar, and also by drying. Gelatin is less easily applied and offers no advantages. If used, the vessels and the solution must be warm.

These require more time in hardening than when mucilage or albumin are used.

GOLD AND SILVER COATING. — This form of coating is very old, but is not now used as much as formerly except for cachous. Gold and silver leaf are used, the pills being first moistened with a little weak mucilage (care being taken not to use too much), then shaken with the leaf. The shaking must be continued for some time, and a second coating is often necessary to give a bright and smooth appearance, and entirely conceal the color of the pill mass. Aluminum leaf may be used in place of silver leaf for the first coating. Being afterward covered with silver, the pills are just as bright and the cost of materials is less.

This is one of the easiest forms of coating to apply, and is readily employed at the dispensing counter. But the pills must not be too wet or the coating will not cover the pills well, and will be dull and irregular. One leaf of silver or gold is sufficient to coat six to a dozen pills, according to size. If the pills contain any sulphides they must first be coated with tolu or sandaric to prevent the discoloration of the silver after-coating. Gold leaf is much better for these.

If a bright surface is not obtained, after the pills are well covered with the leaf, they should be moistened (not wetted) with alcohol and again shaken with a little fresh leaf. This will usually produce a polished surface.

GELATIN COATING is the most common form of coating at the present time. It is attractive in appearance, practically tasteless, and is readily dissolved in the stomach. Pills which are to be gelatin-coated should be firm, but not too hard, and should contain no glycerin.

The pills are partially dried before coating, so as to form a crust on the surface of the pills upon which the gelatin sets.

The latter shrinks on cooling and presses upon the contents of the pill, and, unless the mass is firm enough to withstand the pressure, some of the interior of the mass may be forced out through the pin-hole of the coating, as is sometimes seen in commercial pills.

Pills are frequently covered by an inert powder before coating, in order to present a brighter and more even appearance. This is particularly true of black pills which are shaken just before coating in a little moist lamp-black, so that the finished pills are jet black and glossy, though the mass may have been grayish- or brownish-black. In order to judge of the color of a coated pill it is necessary to cut or break it open and observe the interior of the mass.

Pills which are not readily soluble in aqueous solutions, as quinine pills, reduced iron, etc., and which are non-resinous in character, are easily coated with gelatin, and, after a little practice, may be satisfactorily done at the store, but the coating of all kinds of pills calls for much skill and experience.

The behavior of the coating varies with pills of different character, and the consistence and temperature of the gelatin solution into which the pills are dipped are matters of importance. In general, a hot and thin solution gives the best coating but if resinous pills are dipped into such, the resins will be softened by the heat and the pills are likely to spurt. Likewise, with very soluble ingredients, as sodium salicylate, the momentary contact of the pill with the hot liquid is enough to partially liquefy the surface of the pill and the shape is spoiled. Such pills need to be dipped in a solution which is kept as cool as possible.

The scum which rises upon the surface of the gelatin solution must be brushed aside each time, and the pills dipped only into a clear solution, or air bubbles or other irregularities will show themselves upon the surface of the pill.

The solution should always be heated by steam or a water-bath, as it is quite likely to burn if direct heat be applied.

Various formulas for the coating solution are in use, some being secret and carefully guarded by the manufacturers. Professor Patch's formula gives good results. Best French gold-labelled gelatin, 2½ ounces avoirdupois; distilled water, 7 fluidounces. Digest the gelatin in the water until a clear solution is obtained, then add ½ ounce of sugar, 2 drachms of powdered boric acid, and slowly, 2 fluidounces of mucilage of acacia, U. S. P.

Strain into suitable containers and allow to solidify. This forms a dense stock-jelly, which needs to be diluted with water when used for coating.

Only the best white gelatin and white gum acacia should be used, particularly for white pills. Even with dark-colored pills a much handsomer coating is secured when clean and white materials are used.

The hot solution should be kept covered while in use to prevent loss of water by evaporation. It should also be stirred each time the pills are dipped to keep it of uniform consistence. Never use a solution into which dark-colored pills have been dipped for coating white pills.

The most common method of coating with gelatin is by impaling the pills upon the points of needles, the latter being set into a suitable frame so that a number of pills may be impaled and dipped at once. Several machines are in the market suitable for use on a small scale, one of the best being Professor Patch's machine. Full directions for use are given with each machine, so that these are unnecessary here.

In an emergency a few pills may be coated by sticking a dozen or more needles through a specie cork, the pills then being impaled upon the ends of the needles and dipped into the solution.

The cork with its load is now kept in irregular motion to prevent the coating solution from flowing to one side of the pills, until the solution has set, and after being allowed to stand until the coating is hard they may be removed from the needles. Another method, much less satisfactory, is to place a few drops of the solution in a warm capsule, and roll the pills in this in the same manner as coating with tolu. Care must be taken not to use too much of the solution, and not to have the capsule too warm.

The needle method is open to the objections that a minute hole is left in the pill and the coating, through which some of the mass may be forced by the contraction of the coating; a little spur of coating also remains when the needle is removed, caused by the coating which adhered to the surface of the needle above the pill. The spur is removed by attrition or by cutting with small curved scissors.

In order to obviate these objections there are in use machines in which the needles are replaced by minute tubes terminating in a little cup which is not large enough to cover the pill. A series of such tubes are connected through a common bar-tube with an air-pump.

The pills having been placed in suitable sockets are covered with these little cups, the air sucked out of the apparatus and the pills are held upon the cups by air-pressure. The external portion of the pill is then dipped into the solution, and when dry the pills are reversed and the uncoated portion dipped. In this way a smooth coating is obtained in which there are no holes. Such an apparatus is too complicated and expensive for any except the largest manufacturers.

KERATIN COATING.*— Keratin is a product obtained by exhausting horn, bristles, feathers, etc., successively in ether, alcohol and dilute acids.

The exhaustion requires digestion for a long time — twenty-four hours to eight days.

It is insoluble in water, swells in dilute acetic acid or alkalies, and dissolves in them when warmed; hence it is not soluble in the stomach, but is dissolved in the alkaline secretions of the intestines.

It is used as a coating for pills intended to pass through the stomach unchanged and dissolve in the intestines. Such are (1) medicines which may irritate the mucous membrane of the stomach, such as arsenic, creosote, iron preparations, mercurial preparations, phosphorus and anthelmintics.

(2) Medicines which may hinder digestion by producing insoluble or inactive preparations with the gastric juice, such as tannin, alum, acetate of lead, corrosive sublimate, alkalies, sulphide of calcium, etc.

(3) Medicines which should arrive in the intestines in as concentrated form as possible, such as kousso, male fern preparations, santonin, etc.

Pills so coated are sometimes called *enteric pills.*

When used for coating pills, either ammonia water and dilute alcohol in equal parts, or acetic acid, may be used as a solvent, the liquids being heated to effect solution.

The choice of solvent will depend upon the character of the pills to be coated, avoiding any incompatibilities. Thus the acetic acid solutions should be used to coat pills containing metallic salts, acids, creosote, etc., while the alkaline solution is better for pills containing alkalies, sulphides, pancreatin, etc.

The pills should not be made with an aqueous excipient, or they will shrink, and fissures will be formed when coated.

A mixture of one part wax with ten parts cacao butter is recommended by E. Bourquelot for an incipient. It is also necessary to avoid the use of vegetable dusting-powders, and to employ kaolin or charcoal in their place.

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* See Amer. Jour. Pharm., 1889, page 421.

The finished pills are dipped in melted cacao butter, rolled in charcoal, then sprinkled with a suitable quantity of the keratin solution and rolled until dry. The sprinkling and drying are repeated several times, until a sufficiently thick coating of keratin is obtained.

The pills should not be stuck upon needles and then dipped into the solution, as in gelatin coating, because the pin-holes are not easily stopped, and offer a chance for disintegration of the pill in the stomach.

Pills coated with keratin should not crack nor liquefy after remaining in water for some time.

Salol is frequently used as a coating for the same purpose as keratin, viz.: to prevent the pills from dissolving in the stomach, but allow them to dissolve in the intestines. It may be used in ethereal solution in the same manner as other varnishes, or the salol may be melted in a small capsule, and the pills rolled in the fluid, taking care not to use too much of the salol at one time. But little heat is required, as salol melts at about 45° C. (112° F.).

Success with salol coating depends upon attention to details. The salol is first melted in a suitable dish, the entire bottom of which must be heated, or, the melted salol will crystallize when flowed about the dish. One-half to one grain of salol is needed per pill. Avoid overheating the salol, to prevent the coating chipping off after it is applied. The pills must be smooth, and when finished are best dispensed in a box lined with cotton to prevent breaking, the coating being brittle.

An ether solution of salol makes a more friable coating than the melted salol.

Any of the ordinary excipients may be used for making the pills, except glycerin. When used as a varnish, it may be combined with an equal weight of shellac, the mixture being dissolved in ether, or 2 Gm. of salol and 0.5 Gm. of tannin are dissolved in ether (10 C.c.).

Collodion is also used, though rarely, for intestinal pills. The surface of the pills should be dry when this is applied (except when oily excipients are used), else the coating will peel off. It is applied in the same manner as tolu coating.

PILLS.

164.

℞.	Asafetida	20 Gm.
	Soap, in fine powder	6 Gm.
	Water, a sufficient quantity to make one hundred pills.	
M.	Sig. — Asafetida pills, U. S. P.	

"Beat the solids together with water, so as to form a mass, and divide it into one hundred (100) pills."

Make 20 pills. These are best made in a slightly warm mortar.

165.

℞. Pulveris opii,
Acidi tannici . . . . . āā 0.650
Misce et fiant in pilulas . . . No. x
M. Sig.—Opium and Tannic acid pills.

Mass with 5 drops of glycerin, added at one time.

166.

℞. Pilulæ Quininæ Sulphatis . . āā .065
. . . . No. xxx
Sig. — "One grain quinine pills."

Make in two ways.
(*a*) Mass with glucose excipient.
(*b*) Add .325 Gm. of tartaric acid, and mass with syrup.

Roll and cut on the tile and use starch as a dusting powder, for each method. These pills should be white.

167.

℞. Morphinæ sulphat 0.008
Fiant pilulæ tales . . . . . No. xvi
M. Sig. — "Morphine, ⅛ gr."

Triturate with three times its weight of starch and mass with glucose excipient. Use starch as a dusting powder, and roll out and cut on the tile. These pills should be white.

168.

℞. Sodii salicylatis 3.250
Fiat massa in pilulas decem dividenda. Sig. — Salicylate pills.

Mass cautiously with glucose.

169.

℞. Pulv. digitalis . . . . . . gr. x
Pulv. colchici sem. . . . . gr. xx
Sodii bicarb. . . . . gr. xxx
M. Ft. massa et in pil. xx no. divid.

Add 5 grains of soap and mass with syrup. The large amount of oil in colchicum seed repels aqueous excipients unless combined with soap.

170.

℞. Camphoræ . . . . gr. xxxvj
Saponis pulv. . . . . . . gr. vj
Olei ricini . . . . q. s.
M. Ft. pil. no. xij. Sig. — "3 gr. Camphor pills."

171.

℞. Pulv. opii 0.325
Camphoræ 0.650
M. Fiat massa et in pilulæ decem dividenda. Sig.—Opium and camphor. More dictu.

Add 0.2 Gm. powdered soap, and mass with water.

172.

℞. Ferri et quininæ citratis . . . . ʒ ss
M. Fiat pilulæ no. x. Sig. — Tonic pills. Cap. unam post cibo.

Mix with 5 grains of extract of licorice and mass with glucose.

173.

℞. Pill potassii iodidi . . . . āā gr. iv
. . . . No. xij
M. Sig. — Potassium iodide pills.

(*a*) Powder the iodide very finely, mix with a double-weight of starch, and mass with glucose.

(*b*) Dissolve the iodide in the smallest possible amount of warm water (about

℥ ss), add ten grains powdered tragacanth, and sufficient kaolin or talc to make a mass. The pills should be white.

(*c*) Mass with anhydrous lanolin.

174.

℞. Potassii iodidi 2.00
Olei theobromatis 2.00
Petrolati . . . . q. s.
M. Ft. pil. no. xx. Sig. — "Iodide pills."

175.

Mercury . . . . 33 Gm.
Glycyrrhiza, in No. 60 powder 5 Gm.
Althæa, in No. 60 powder . 25 Gm.
Glycerin . . . . 3 Gm.
Honey of rose . . . . . . 34 Gm.
M. Sig. — Blue Pill, U. S. P.

"Triturate the mercury with the honey of rose and glycerin until it is extinguished. Then gradually add the glycyrrhiza and althæa, and continue the trituration until globules of mercury are no longer visible under a lens magnifying at least ten diameters."

Make twenty grams.

176.

℞. Massæ hydrargyri . . . . . . q. s.
Fiat pilulæ viginti, ana . . . 0.325
Sig. — "Blue Pills."
Nocte una sumenda.

Roll, cut and finish these on the pill machine without using the finisher or fingers to round them.

Do not weigh the mass, but return what is left to the container. Weigh the finished pills.

177.

℞. Aloes . . . . gr. ij
Massæ hydrarg. . . . . . . gr. j
Resinæ podophylli . . . . . gr. ¼
M. Ft. pil. tales xij no.
Sig. — Cathartic pills.

This will mass more easily in a warm mortar. Add a little soap and water if needed.

178.

℞. Hydrarg. chlorid mitis 1.5
Cambogia 0.4
Ext. Jalapæ 0.75
Ext. colocynth comp. 2.0
Fiant pilulæ xxv no.
Sig. — "Compound Cathartic Pills, U. S. P."

Mass with syrup.

179.

℞. Phosphori 0.065
Glycyrrhizæ pulv. 4.000
Tragacanthæ pulv 0.300
M. Ft. pil. lx no.
Sig. — "Phosphorus pills."

To weigh the phosphorus, counterpoise a small capsule or watch-glass containing a little water, cut off a piece of phosphorus under water of the judged size, dry by pressing between filter-paper, drop into the water and weigh.

If too heavy take out, *again counterpoise the water*, and repeat until the desired weight is obtained.

Dry the weighed phosphorus as before, and put into a test tube with 6 C.c. of chloroform. When dissolved, pour upon the licorice powder in the mortar, stir gently to distribute the liquid through the mixture and favor evaporation.

When the chloroform has mostly evaporated and the powder is still decidedly moist, add the tragacanth and ten drops of glycerin. Work together and add enough syrup to make a mass.

Coat the pills as soon as finished with tolu.

180.

℞. Phosphori	.065
Glycyrrhizæ pulv.	4.00
Tragacanth pulv.	0.30
Glycerini	0.63
Syrupi	q. s.
Chloroformi	6.00

M. Fac pilulas xx no.
Sig. — Phosphorus pills, U. S. P.

Weigh the phosphorus carefully (see preceding ℞.), dry with filter-paper and dissolve in the chloroform. Pour this solution upon the powdered licorice root, stir to diffuse it thoroughly, and when the chloroform has almost (not entirely) evaporated add the tragacanth and glycerin, and enough syrup to make a mass. Mass quickly.

Coat the pills with tolu.

181.

℞. Sodii bicarbonatis	1.30
Pulv. rhei	0.650
Olei menthæ viridis	0.325

M. Ft. pil. x no.
Sig. — "Soda-mint pills."

Mass with glucose excipient or with glycerin.

182.

℞. Ferri reducti	0.130

Fiat pil. no. i.
Mitte L.
Sig. — "Reduced iron."

Triturate the iron with one-tenth its weight of powdered extract of licorice and mass with glucose excipient.

183.

℞. Aloini	gr. $\frac{1}{5}$
Strychninæ sul.	gr. $\frac{1}{60}$
Ext. belladonnæ	gr. $\frac{1}{8}$

M. Ft. pil. tales xxx no.
Sig. — A. S. & B. pills.

Mix the strychnine with the aloin, then with 20 grains of powdered licorice root. Soften the ext. belladonna with syrup, incorporated with the mixed powders and mass with syrup.

184.

℞. Strychninæ sulphat.	0.065
Acid arsenosi	0.065
Ferri sulphat exsiccati	0.650

M. Ft. massa in pil. x dividenda.
Sig. — Iron, arsenic and strychnine.

Mix well, according to art, and use .5 Gm. powdered extract of licorice, and glucose as excipient.

185.

℞. Quininæ sulphatis	ʒ ss
Ferri reducti	ʒ j
Acidi arsenosi	gr. ij
Spiritis glonoini	ʒ ss

M. Ft. massæ et in pil. xxx no. divide.

Nitroglycerin explodes violently if triturated. Mix well the first three ingredients add the spirit, and stir quickly and lightly, in order to diffuse it, add the excipient (glucose, mucil. tragac., etc.) and mass before the spirit can evaporate.

186.

℞. Opii pulv.	gr. vj
Plumbi acetat	gr. xij

M. Ft. pil. xij no.
Sig. — Lead and opium.
(State excipient used.)

187.

℞. Plumbi acetatis	gr. xvj
Camphoræ	gr. xij
Opii pulveris	gr. iij
Bismuthi subnit	gr. xij
Ext. gentianæ	q. s.

Misce fiat massa et in pil. duodecim divide.

Sig. — "Thompson's Diarrhœa Pills."

188.

℞. Calcis sulphuratæ	gr. j
Sacchari lactis	gr. viij

Misce fiat pilulæ viij no.
Conspergentur cinnamomi.
Sig. — "Calcium Sulphide."

Use mucilage of tragacanth as excipient.

189.

℞. Camphoræ,	
Tinct. valerianæ	āā gr. vj

M. Ft. pil. xij no.
Consperga pulvero aromatica.

190.

℞. Potassii permanganatis	1.30

Fiat pil no. x.
Sig. — Permanganate pills.

Powder the permanganate and mix with 1 Gm. of kaolin or of talcum. Mass with petrolatum, to which a little paraffin has been added. (Melt together .2 Gm. paraffin and .6 of petrolatum for excipient.) Use horn spatula and cut on pill-tile, avoid contact with metals.

191.

℞. Potassii permanganatis,	
Ferri reducti	āā ʒ j
Quininæ sulphatis	ʒ iss

M. Fiat pilulæ xlviij no.

Mix the permanganate with half a drachm each of petroleum and paraffin, previously melted together, add the iron, then the quinine. If too soft stiffen with a little kaolin or talcum. Use horn spatula and cut on pill-tile.

192.

℞. Potass. permanganat.,	
Ext. ergotæ	āā gr. xij

M. Ft. pil. xij no.

If mixed directly, the permanganate will be decomposed, and the mass will crumble.

Make two masses, one of the extract of ergot with powdered althæa, which is then rolled into a pipe in the usual manner, cut into 12 parts and each part flattened into a disc; mass the permanganate with petrolatum, roll into pills, powder well with talcum and place the pills so made in the center of the ergot discs. Now fold the discs around the permanganate pills, roll into shape and coat with tolu. This gives a permanganate pill at the center, a coating of extract of ergot, and a final protecting coating of tolu. (H. Wyatt, Jr.)

193.

℞. Pilulæ argenti nitratis	gr. ss

No. vj.
Sig. — One in the morning, fasting.

Make in the same way as permanganate pills. Or mix with 3 grains of Venice turpentine, then add sufficient powdered charcoal to make a mass and divide. These can be gelatin coated.

194.

Ferrous sulphate, in clear crystals	16 Gm.
Potassium carbonate	8 Gm.
Sugar	4 Gm.
Tragacanth, in fine powder	1 Gm.
Althæa, in No. 60 powder	1 Gm.
Glycerin	
Water, each a sufficient quantity to make 100 pills	

Sig. — Blaud's pills, U. S. P.

"Rub the carbonate of potassium, in a mortar, with a sufficient quantity (about ten (10) drops each) of glycerin and water, then add the ferrous sulphate and sugar, previously triturated together to a uniform powder, and beat the mass thoroughly, until it assumes a greenish color. When the reaction appears to have terminated, incorporate the tragacanth and althæa, and, if necessary, add a little more water, so as to obtain a mass of a pilular consistence. Divide this into one hundred (100) pills."

"These pills should be freshly prepared, when wanted."

Make 25 pills. Too much excipient is directed. Use two drops each of glycerin and water for 25 pills.

195.

Reduced iron	4 Gm.
Iodine	5 Gm.
Glycyrrhiza, in No. 60 powder	4 Gm.
Sugar, in fine powder	4 Gm.
Extract of glycyrrhiza, in fine powder	1 Gm.
Acacia, in fine powder	1 Gm.
Water	
Balsam of tolu	
Ether, each a sufficient quantity to make one hundred pills	

M. Sig. — Blancard's pills, U. S. P.

"To the reduced iron, contained in a small mortar, add six (6) cubic centimeters of water, and then, gradually, the iodine, constantly triturating until the mixture ceases to have a reddish tint. Then add the remaining powders, previously well mixed together, and mix the whole thoroughly. Transfer the mass to a porcelain capsule, and evaporate the excess of moisture on a water-bath, with constant stirring, until the mass has acquired a pilular consistence. Then divide into one hundred (100) pills." Coat with tolu.

Make 50 pills. Avoid evaporating too much. The mass stiffens considerably on cooling.

196.

℞. Strych. sulph.	gr. iss
Aloini	gr. iij
Iodi	gr. j
Ferri reducti	ʒ j
Ext. quassiæ	gr. xlv

M. Fiant pilulæ no. xxx.

Place ten grains of the iron in a mortar moistened with ten minims of a mixture of water and glycerin and add the iodine. Stir until the color of iodine has disappeared (showing complete formation of ferrous iodide), add the remainder of the iron, then the strychnine and aloin and incorporate the extract. Roll into pills.

197.

℞. Ferri valerianat.,	
Quininæ valerianat.,	
Ammonii valerianat.	āā ℈ j

M. Ft. pil. xx no. Sig. — One t. i. d.

When mixed these form a semi-fluid mass. Althæa should be added to stiffen and no other excipient is needed.

198.

℞. Iodoformi,	
Creosoti,	
Benzoini,	
Balsami tolutani	āā gr. j

M. Ft. pil. tales xij.

199.

℞. Lupulini,
Camphoræ . . . . āā gr. x
M. Ft. Massa in pilulæ decem dividenda.

Powder the camphor by means of a little ether, mix with the lupulin, work thoroughly and roll. The massing is hastened by using a warm mortar. No excipient is needed.

200.

℞. Copaibæ . . . . 94 Gm.
Magnesia. . . . . 6 Gm.
Water a sufficient quantity.
M. s. a. Sig.—Copaiba mass, U.S.P.

"Triturate the magnesia with a little water, in a capsule, until the powder is uniformly dampened throughout. Then gradually incorporate with it the copaiba so that a uniform mixture may result, place the capsule on a water-bath, and heat during half an hour, frequently stirring. Lastly, transfer the mixture to a suitable vessel, and set this aside until the mass has acquired a pilular consistence."

Make one-fifth the quantity.

If this does not form a sufficiently stiff mass, the addition of a little resin of copaiba will usually aid in giving a proper consistency.

201.

℞. Copaibæ 10
M. Ft. pil. no. xxx.

Triturate the copaiba with 3.4 Gm. of powdered acacia, add 5 C.c. of water and emulsify. Add 1 Gm. magnesia and let stand over night, then add powdered borax, incorporate and roll. (The mixture of magnesia and emulsion of copaiba may be kept in stock if desired)

202.

℞. Creosoti 1.0
Pulv. glycyrrhizæ rad. 1.9
Pulv. glycyrrhizæ ext. 1.0
Glycerini 0.1
M. Fac pilulæ no. xv. Sig. — "One-grain creosote pills."

203.

℞. Creosoti 1.0
Farinæ tritici,
Syrupi . . . . āā q. s.
M. Ft. pil no. xv. Sig.—"One-grain creosote pills."

Make a stiff mass with the creosote and a sufficient quantity of wheat flour, and add a few drops of syrup or honey to impart plasticity.

204.

℞. Creosoti . . . . m. xij
Pulv. glycyrrhizæ . . . . . gr. xviij
Pulv. ext. glycyrrhizæ . . . gr. xij
Misce. Ft. pil. xij no.
Sig. — "One-grain creosote pills."

Use glucose or glycerin for excipient.

205.

℞. Creosoti. . . . . gr. xxx
Saponis pulv. . . . . q. s.
Ft. massa in pil. xx. divide.
Sig. — "1½ gr. creosote pills.'

206.

℞. Creosoti . . . . gr. xxx
Pulv. glycyrrhizæ . . . . . ʒ j
Albuminis ovi rec . . . . . q. s.
M. Ft. pil. xx no.
Sig. — "1½ gr. creosote pills."

207.

℞. Creosoti . . . . ʒ ss
Ceræ flavæ . . . . gr. x
Pulv. glycyrrhizæ . . . . . . q. s.
M. Ft. pil. xx no.
Sig. — "1½ gr creosote pills."

208.

℞. Creosoti . . . . gr. xxx
Gelatini comp. . . . . gr. xv
Ext. glycyrrhizæ . . . . . q. s.
M. Ft. pil. x no.
Sig. — 3 gr. creosote pills.

Make the gelatin compound by dissolving 11 parts of gelatin and 5 parts of sugar in 24 parts of hot water.

209.

℞. Olei tiglii . . . . m. vj
Fiat pil. iv no.
Sig. — Croton oil pills.

Add ten grains of flour and two grains of soap, then glucose q. s.

210.

℞. Olei tiglii . . . . m. v
Saponis,
Pulv. acaciæ . . . . āā ℈ j
M. Ft. massa in pilulæ viginti numero dividenda.
Sig. — Croton oil, ¼ gr.

(Caution must be exercised in handling this mass to avoid its irritant action on the skin.)

211.

℞. Lupulini . . . . gr. vj
Camphoræ . . . . gr. iss
Terebinth. Venet. . . . . . . gr. xij
M. Ft. massa et in pilulæ xii numero divide.

Needs licorice powder or magnesia to make a mass.

212.

℞. Terebinthinæ Venetæ . . . . ʒ ss
Extracti hyoscyami . . . . . ʒ ss
Pulveris rhei . . . . ʒ ss
Camphoræ . . . . gr. x
M. et in pil. xxiv divide.

213.

℞. Chloralis,
Camphoræ . . . . . . āā gr. xviij
M. Ft. pil. xij no.

Mix the chloral and camphor thoroughly and mass with 50 grains of flour and 6 drops of syrup (or q. s.). Or, add half a drachm of melted wax, and incorporate enough powdered licorice root to make a mass.

214.

℞. Terebeni,
Picis liquidæ . . . . āā ʒ ss
Balsami peruviani,
Sodii benzoatis . . . . . . āā ʒ j
M. Ft. pil xxxv.
Sig. One every 4 hours.

CHAPTER VIII.

LOZENGES, PASTILS, ETC.

Lozenges are small discs of medicated or flavored sugar, intended to be dissolved in the mouth. The word lozenge is used in a broad sense, and refers to the form in which the medicinal matter is stored or administered. It may be applied to troches, tablets, pastilles, etc., all of which are broadly called lozenges, but the other terms are used in a more restricted sense.

Troche (Lat. *Trochiscus, i*) (pronounced trōch or trō′kē), a lozenge composed of medicinal ingredients mixed into a paste with sugar and mucilage and dried. It is intended to be gradually dissolved in the mouth and slowly swallowed, producing a demulcent effect.

Pastil or Pastille (pas-tel′) (Lat. *Pastillus, i*). — The Latin word *pastillus* is the diminutive for *panis*, a loaf, and thus means properly a little loaf. In pharmacy the word is used somewhat indefinitely, referring mostly to lozenges having gelatin and glycerin, or chocolate for a base.

Chocolate lozenges are called pastils in the German Pharmacopœia, but "tabellæ" in the British.

Fumigating pastils are little cone-shaped compounds of balsam, spices, etc., with charcoal or other combustible substances as a base, designed for burning as a fumigator or disinfectant.

Bacill (Lat. *Bacillula, æ*), a short, rod-like lozenge corresponding to troche, except in shape. It is a more convenient form for the small troches.

Lamel (Lat. *Lamella, æ*). — Minute glycero-gelatine discs medicated for use in the eyes or for hypodermic injections.

Orbicules or Globules (Lat. *Rotula, æ*), are hemispherical globules of sugar, medicated by dropping upon their surface a volatile oil, which is absorbed.

THESE classes of preparations, though largely sold in drug stores, are not made to any considerable extent by pharmacists.

They are, properly, medicated candies, and require special apparatus and skill to obtain tempting products. The numerous candy cough-drops are included here, which might be included in the domain of pharmacy but that they require a skill in the manipulation of melted sugars and special moulds, work-benches, etc., which will confine them to the work of the manufacturing confectioners.

Many of the smallest medicated lozenges are coated heavily with sugar, and are thus rendered more candy-like, while the chocolate lozenges and the bacillula suggest other familiar forms of confectionery.

Nearly all the common forms of candy have been utilized for the administration of medicines, but one form, which has appeared in the market in late years, has not yet found such a use, though it is quite suggestive of possibilities, perhaps in the line of cough-drops or similar agents.

These are the brandy or liquor-drops, consisting of a chocolate-coated shell of sugar, containing a thick brandy or rum-syrup. On breaking one of these open, the outside of the shell is seen to be quite smooth, while the inside is very irregular, and has the appearance of rock candy. This suggests their method of manufacture. If brandy (diluted or strong) be heated, and sugar added thereto until no more will dissolve, a hot supersaturated syrup is formed from which crystals of sugar will separate on cooling.

If this hot solution be poured into small metallic moulds, while hot, the solution will cool first upon the sides of the moulds and crystallize there, so that when the moulds have set for several hours a crust of crystallized sugar will have formed on the inner surface of the mould, and will inclose the remaining syrupy liquid which will not crystallize. On removing these from the mould they may be coated with chocolate or other material for which no pressure or continued heat are required.

An application of this principle to a cough-drop, or other medicament, might easily be made, but has not yet appeared to the author's knowledge.

In the following pages only such forms of lozenges are treated as are official in the principal pharmacopœias, and are liable to be prescribed by physicians, or can be profitably made in the pharmaceutical laboratory.

Troches are made of various forms, the more common being round or rectangular. No shape is specified in the Pharmacopœia and consequently the pharmacist is free to dispense any form which comes within the definition of troches. The manufacturers, by whom most of the troches at the present time are made, use dies of various shapes and sometimes arranged to stamp some name or design upon the face of the troche.

Such dies consist of a metallic cylinder with a cutting edge, into which is sometimes fitted a plunger, bearing upon its face the design in bas-relief or intaglio, which, being forced upon the soft mass, leaves its impression upon the troche. The mass, having been rolled into a flat sheet, either upon a troche board or between adjustable metallic rollers, is then cut by hand with these dies, the latter being either single or in sets.

A troche-mass consists of medicinal matter, mixed with sugar and gum, made into a dough by means of syrup or honey. When no dry gum is used the mass is made with mucilage. It should be made softer than a pill mass, so that it may be moulded and flattened without cracking. Moistening agents should be added very cautiously, since sugar softens by kneading, and a little liquid which appears to be insufficient to produce plasticity, may, upon being well worked in, produce a mass which lacks firmness. When the troche contains acacia, it is usually mixed with the sugar in dry form, but when tragacanth is used the mucilage of tragacanth is preferred as an excipient.

The choice of these two gums depends upon the purpose of the troche as well as upon its ingredients. Acacia makes a more tenacious troche which dissolves more slowly than when tragacanth is used.

It is to be preferred, therefore, for throat lozenges and such as are desired to dissolve slowly. The proportion of gum present controls to a large extent the rate of solubility.

The sugar should be in a very fine powder, or the surface of the troche will not be smooth. That sold under the name of "confectioners' sugar" is best to use. It has been recommended to reserve a portion of the sugar from the mass until the excipient has all been added and kneaded in, then the reserve portion is incorporated; this is to avoid an unduly soft mass, but such proceeding is not necessary if the excipient be added cautiously.

White of egg and syrup of marshmallow are sometimes used as excipients in place of mucilage. These do not make as hard a troche, unless gum is also present, but they are very palatable. For laxative troches prune-paste is an agreeable excipient.

If a troche-board and cutter is at hand, the mass is now weighed, and the weight divided by the number of troches desired. The weight of one troche having thus been ascertained, the amount is weighed out and formed into a troche in the cutter, in order to ascertain its thickness. The sides of the troche-board are now adjusted to correspond to this, and the entire mass rolled into a sheet of corresponding thickness, which is then cut into troches by means of the cutter.

In rolling and cutting the mass a dusting-powder is usually necessary. Powdered sugar of milk is usually best for this, being less hygroscopic than cane sugar, and less quickly absorbed by the mass. Starch is also used. When dark-colored troches are made, an aromatic powder, as cinnamon, orris, etc., may be employed in very sparing quantities. These should be avoided, unless the aromatic flavor will harmonize with that of the troche. Less powder will be needed if the mass is rolled and cut upon paraffin paper. Few stores are provided with troche apparatus, because most of these medicaments are now made by the large manufacturers. A fairly good troche can be made, however, without the use of special apparatus, and no pharmacist need turn away a prescription for a troche which he does not keep in stock because of the lack of such convenience. If a troche-cutter is at hand the mass may be rolled into a sheet upon the pill-machine or tile by means of a round, smooth-sided bottle. Or in the absence of a troche-cutter the mass is first made into boli, in the same manner as making pills. These, after having been well rounded, are pressed into a flat form by means of a broad spatula or a flat board, care being taken to have all of the same size. A good method is to flatten a number together upon the pill-machine, using the raised sides of the machine as a gauge for thickness. Very good-looking troches can be made in this way if the mass is made very soft. With a dry or stiff mass the edge of the troche will crack and be uneven, but with a soft mass a smooth and round edge is obtained. The mass should always be divided as soon as made.

Instead of flattening the bolus with a spatula or board, a troche-former may be used. This consists of a smooth metallic tube about three inches in length, the diameter of which is the same as that of the troches desired. Into this is fitted, not too tightly,a rod of wood or metal which is used as a plunger and is longer than the cylinder. The tube is now placed in an upright position over the bolus, so that the latter rests upon the pill-tile inside the tube. The plunger is then pressed gently upon the bolus and the latter is thereby formed into a troche.

If the bottom of the plunger has cut into or raised upon its surface a suitable design the latter will appear in reverse upon the surface of the troche.

Another method of forming the troche is to force the mass through a glass tube, which has been slightly greased on the inside, and cut the mass into lozenges as it emerges.

All troches should be partially dried before being delivered. In most cases drying in a warm place — as near a stove or radiator — for about an hour is sufficient; but when the troches contain volatile ingredients, essential oils, etc., heat should be avoided. These should be dried in a desiccator, which may be readily improvised by placing them in a tight pasteboard or wood box, alongside a lump of quicklime. The lime abstracts the water greedily, but does not affect the oils.

Troches which contain poisonous substances should either be colored or stamped in such a way as to warn against their too free use. Commercial santonine lozengers are usually colored pink for this reason.

BACILLS.

Short, rod-like lozenges are the form in which the smallest troches are sometimes preferred. They are also dispensed in the place of round troches when special apparatus for these are wanting.

They may be made by rolling the mass into a pipe, as in making pills, then cutting into short lengths, or a smoother surface may sometimes be obtained by flattening the pipe between the cutters of the pill machine, so that it is forced into the grooves.

In the German pharmacopœia this form is directed for troches weighing less than ten grains.

PASTILS.

Pastils or pastilles (pronounced pas′-til or pas-tel′) are soft lozenges, having, usually, gelatin or chocolate for a base. Glycerin is associated with the gelatin to keep the mass soft.

A formula which is popular in England is gelatin one part, glycerin and water each two and one-half parts by weight. The gelatin is softened in the water by aid of heat, and then the glycerin is added and the heat continued until a clear solution results. This sets on cooling to a firm, transparent jelly, which dissolves slowly in the mouth.

Medicinal agents are added just before the solution stiffens, and stirred until the mass becomes firm enough to remain homogeneous. When insoluble powders are added they should first be made into a stiff paste with a little glycerin.

The pastils are flavored with fruit juices and acids, with aromatics, etc.

Rose water, cinnamon-, orange flower-, or bitter almond-water may be substituted for the water used to dissolve the gelatin. Glycyrrhizin in the proportion of 24 grains to 1 ounce of gelatin makes a good flavor for pastils of ammonium chloride.

The pastils may also be colored with carmine if desired.

To form the pastils the melted mass is allowed to congeal upon a flat surface, having raised sides or edges, so that it will form a square or rectangular sheet of the size and thickness desired. When cold this is cut into squares with a sharp knife. Moulds can be obtained of glass or tin which have the bottom marked with lines to indicate the squares of the finished troche, and any measurements are unnecessary. In the absence of these fairly good results may be obtained by allowing the mass to congeal in the bottom of a tin seidlitz-powder box, or in the pasteboard cover of a powder box of suitable size, which has previously been oiled to prevent sticking.

The sheet of gelatin is then taken out and cut into suitable pieces by eye or measurement.

Pastils containing active ingredients of a volatile or changeable character should be freshly prepared, but in many cases these can be kept for a considerable time if coated with gelatin while fresh. Unless otherwise specified, pastils of gelatin should weigh about thirty grains each.

A more slowly soluble mass for throat affections may be obtained by addition of acacia. A good formula is: Gelatin, 1 ounce; glycerin, 2½ ounces; acacia, 2 drachms; aromatic water, 2 ounces.

A still more slowly soluble mass is made without gelatin as follows: 18 parts of gum acacia and 6 of sugar are dissolved in 80 parts of water, and the solution is strained. It is then evaporated to 30 parts, the medicinal agent added, and the mixture, after it has become transparent, is poured into moulds.

Chocolate pastils are made by fusion in a similar manner to those of gelatin, or by the cold method in a manner similar to the making of troches and bacills. The commercial sweet chocolate may be used, or a mixture of equal parts of cacao butter and sugar with one fourth to one half these quantities of cacao, as best suits the case. The latter is preferable for pastils which contain much insoluble or liquid matter.

The same precautions must be taken in handling of these as in suppositories, which they closely resemble from a manufacturing standpoint. Tragacanth is sometimes recommended to make the mass more adhesive (when some water must be present) and saccharin is also used as a sweetener.

In many cases the sweet chocolate of the market, with addition of a little cacao butter and sugar, suffices for a good mass.

Paraffin may be added if too soft.

LAMELS.

Lamels are minute discs of glycerinated gelatin, containing small doses of active medicinal matter. They are used chiefly in ophthalmic treatment in place of collyria, or for producing dilation or contraction of the pupil, producing anæsthesia, etc. They are made very thin and small, so that they can be inserted underneath the lids.

They may also be used for extemporaneous preparation of hypodermic solutions.

In the British Pharmacopœia three are official, one containing $\frac{1}{5000}$ grain of atropine sulphate, one of $\frac{1}{200}$ grain of cocaine hydrochloride, and one containing $\frac{1}{1000}$ grain of physostigmine in each lamel.

SUGAR GLOBULES OR ORBICULES.

These are small hemispherical globules of sugar made by heating sugar with water until a stiff, pasty mass is obtained, then dropping upon a cold polished surface in such a way as to obtain little half-rounded lozenges of sugar similar to the peppermint drops of the market. These are medicated as desired, with volatile oils, dropped upon the globules. When very small quantities of oils are administered in this way the oil is first diluted with alcohol or ether and the globules saturated with this mixture.

The globules thus correspond to the sugar-pellets of homœopathic pharmacy, except in size and shape, and like them are always obtained from confections ready for medication. They are official in the German Pharmacopœia under the title *Rotulæ Sacchari.*

TROCHES.

215.

Tincture of ginger	20 C.c.
Tragacanth, in fine powder	4 Gm.
Sugar, in fine powder . . .	130 Gm.
Syrup of ginger, a sufficient quantity to make 100 troches.	

M. Sig. — Troches of Ginger, U. S. P.

"Mix the tincture of ginger with the sugar, and, having exposed the mixture to the air until dry, reduce it to a fine powder. To this add the tragacanth, and mix thoroughly. Lastly, with syrup of ginger, form a mass, to be divided into one hundred (100) troches."

Make 20 troches.

216.

Potassium chlorate, in fine powder	30 Gm.
Sugar, in fine powder	120 Gm.
Tragacanth, in fine powder	6 Gm.
Spirit of lemon	1 C.c.
Water, a sufficient quantity.	

Make 100 troches.

Sig. — Potassium chlorate troches, U. S. P.

"Mix the sugar with the tragacanth and the spirit of lemon by trituration, in a mortar; then transfer the mixture to a sheet of paper, and, by means of a bone spatula, mix with it the potassium chlorate, being careful, by avoiding trituration or pressure, to prevent the mixture from igniting or exploding. Lastly, with water, form a mass, to be divided into one hundred (100) troches."

Make 20 troches.

The powders must be mixed and massed very cautiously, as the dry mixture is explosive by friction or pressure.

217.

Prepared chalk	25 Gm.
Acacia, in fine powder	7 Gm.
Spirit of nutmeg	3 C.c.
Sugar, in fine powder	40 Gm.
Water, a sufficient quantity.	

Make 100 troches.

Sig. — Troches of chalk, U. S. P.

"Rub the powders with the spirit of nutmeg until they are thoroughly mixed; then, with water, form a mass, to be divided into one hundred (100) troches.

Make 20 troches.

218

℞.	Olei gaultheriæ	0.20
	Pulveris sacchari	15.00
	Mucilaginis tragacanthæ	q. s.

M. Fiat trochisci viginti no.

Sig. — Wintergreen lozenges.

219.

℞.	Pulv. tragacanthæ	5.0
	Pulv. sacchari	15.0
	Aquæ rosæ fort.	q. s.

M. Ft. trochisci xx no.

Sig. — Throat lozenges.

220.

℞.	Pulv. glycyrrhizæ comp	ℨ iv
	Pulpæ pruni	q. s.

M. Ft. trochisci xxiv no.

Sig. — Compound licorice lozenges.

221.

℞.	Sodii boratis	10
	Sacchari	90
	Tragacanthæ	0.25
	Tinct. benzoini	1.0
	Aquæ	6.0

M. Ft. trochisci no. c.

Mix the borax with half of the sugar, and the tragacanth with the remainder of the sugar. Triturate the tragacanth-and-sugar mixture with the water, add the tincture of benzoin, triturate well, then add the borax mixture, incorporate quickly and divide into 100 troches.

(Borax coagulates gum, and a tough, elastic mass which cannot be worked, is formed if the borax is added directly to the tragacanth. The same would apply to acacia.)

222.

℞.	
Gelatini	5.0
Aquæ bullientis	5.0
Glycerini	0.5
Misce at adde.	
Creosoti	10.0

M. Ft. emulsionis et in pastillos c divide.

Make an emulsion of the hot paste and creosote by rapid trituration, continued until the gelatine stiffens, then allow to congeal and divide.

223.

℞.	
Camphoræ	gr. viij
Menthol	gr. iv.
Pastæ gelatini pro pastillos	q. s.

M. Fac. pastillos no. xij.

Sig. — Sedative pastilles.

224.

℞.	
Iodoformi	gr. xij
Pastæ gelatini pro pastillos	q. s.

M. Ft. pastillos no. xi.

Sig. — Iodoform pastilles.

225.

℞.	
Ext. kola	1
Pulv. chocolate	10
Pulv. milk sugar	1
Syrup	q. s.

M. Ft. pastilli no. x.

Sig. — Kola pastilles.

226.

℞.	
Santonini	ʒ ss
Hydrarg. chlor. mitis	gr. x
Pulv. chocolate	ʒ iss
Sacchari	ʒ v

M. Ft. pastilli xxx no.

Sig. — Santonin lozenges.

227.

℞.	
Hydrarg. chlor. mitis	1
Chocolatæ	20.0
Syrupi	q. s.

M. Ft. pastilli xv no.

Sig. — "Calomel pastilles."

Powder the chocolate and mix the calomel thoroughly, mass with the syrup and divide.

228.

℞.	
Olei ricini	10
Pulv. theobromat. sine oleo	10
Sacchari	20
Tinct. vanillæ	0.50

M. Ft. pastilli no. x.

Sig. — "Castor oil pastilles."

Mix the oil with the cocoa (the powdered cocoa put up for making hot drinks may be used) then with the other ingredients, and roll into pastilles.

CHAPTER IX.

TABLETS.

Tablets have largely taken the place of pills in the administration of medicines, partly because of their quicker solubility and more prompt action, and partly because they can be manufactured more cheaply than pills.

Tablets are of two kinds, the compressed tablets and the **triturate tablets.** They differ materially in character as well as in their method of preparation. The first are formed of *dry material in a granular condition* by compression, while the second are formed of *moist material in very fine powder* in a mold.

COMPRESSED TABLETS.

There are four essentials in making compressed tablets, which must receive consideration. These are :

1. *To regulate the pressure carefully.*
2. *To ensure proper cohesion of the particles that are being compressed and an equal amount of material in each tablet.*
3. *To prevent the adhesion of the material to any portion of the machine.*
4. *To secure readily soluble or medicinally active tablets.*

The first is a mechanical operation, and depends mainly upon the machine.

Tablet machines may be obtained in great variety of form and capacity, and at costs ranging from five to five hundred dollars. They vary mainly in their capacity and the variety of their uses, and in the rapidity of their action.

They may be divided into two classes — the lever machines, operated only by hand, and the geared machines, operated either by hand or by power. The first are suitable only for small operations, as the extemporaneous preparation of a very few tablets. They are fed and operated entirely by hand, and are more liable to get out of adjustment if a large number of tablets are run off upon them.

The geared machines are made for rapid and automatic action, working either by power or by hand, and are adapted for a variety of sizes and styles of tablets. These are capable of making 100 to 500 tablets per minute, and cost from twenty-five dollars upward. A selection of a machine will depend upon the use to which it will be put, and the facilities for operating.

The most important part of the machine is the dies and their fittings. These must be of hardened steel, well fitted and perfectly smooth. Unless the dies fit well into the sockets, and are *perfectly smooth* a perfect tablet cannot be made. If there is a scratch or roughness on the surface, this will fill with the substance that is being compressed and the surface of the tablet will be broken. Every effort must be made to secure and keep smooth dies. As they become worn, burnishing or re-grinding must be resorted to to correct them.

If substances adhere to the dies, they should be removed with warm water or alcohol and a soft cloth or sponge. Never dig it off with a spatula or other metallic tool. The finest machine in the world will not turn out good tables unless the dies are in prime condition.

They must also be protected from corrosion and rust. Some substances, particularly corrosive sublimate and acid salts or acids, act upon steel, and unless the dies are protected they may be ruined by their action. If such substances are compressed, the granulated materials must be well dried, and the dies kept well lubricated. Then, immediately after finishing the tablets, the dies should be taken out of the machine, thoroughly cleaned, and well oiled.

It is advisable to keep the dies and sockets immersed in oil when not in use. The dies in the cheaper machines should be just as good as those in the more expensive machines.

The selection of a machine will depend mainly upon such questions as whether one wishes to make tablets in quantity or only as ordered; whether two sizes of dies are sufficient or a dozen sizes are wanted; whether the machine must be operated by hand or by power; etc. The only general suggestion that may apply, is that in selecting a machine, ease of cleaning and adjustment or change is a matter of quite as much importance as ease of operation. The working parts should be easily accessible and the dies should be easily removed or cleaned.

To operate easily, any machine requires a firm foundation. Unless the machine is to be operated by engine-power, it will be found convenient to fasten it upon a bench somewhat lower than the usual working-counter. A strong box of suitable height makes a portable stand and the interior of the box may be utilized as a container for the necessary tools.

The hardness and weight of the tablets are adjusted by the position of the compressors in the machine. The depth to which the lower die sinks in its socket determines the quantity of material which shall fill the socket, and consequently the weight of the tablet. The depth to which the upper die sinks determines the thickness and the hardness of the tablet.

The lower die is first adjusted to receive the proper quantity of material each time it is filled, and so to make tablets of a definite weight. Then the upper die is adjusted to make the tablets of the required hardness.

Except when tablets are intended to be dissolved slowly in the mouth, hard compression is not desirable. A tablet which will break easily in the fingers, and not break or chip when dropped upon the floor, is considered the proper condition for most tablets.

PREPARATION OF THE MATERIAL. While it is possible to compress fine powders into tablets, if the powders are fed slowly, the tablets will not be as smooth and even in weight as when they are made from granulated materials. Fine powders occlude air and compress unevenly, and they do not feed well into the dies.

To secure good results the material to be compressed should be in a uniformly granular condition, the granules being of such a size that they will just pass easily through a No. 20 sieve. A few special substances are made into finer granules, but these are exceptional.

The method of granulating will vary with the characteristics of the material.

Crystalline salts and chemicals can be obtained in a granular form in the market, and no further preparation is needed. Or if large crystals are at hand, they may be coarsely ground in a mill or mortar, and the fine powder separated by sifting, the coarser granules only being used for compression. It is sufficient then to adjust the machine and simply compress the substance. This, of course, applies mainly to tablets consisting of a single chemical substance. Mixtures may require to be treated as below.

Vegetable drugs, non-crystalline salts, etc., require to be formed into granules by suitable treatment. The substances should first be in fine powder. This is to be moistened with an excipient, chosen, much as a pill-excipient is chosen, with a view to a slight solvent action upon the powder and a moderate degree of adhesiveness. Granulating excipients are more limpid and used in smaller proportion than pill excipients, since a plastic mass is not formed but only a damp, slightly adhesive powder.

Syrup forms the best general excipient. The powders, mixed or single, are placed in a mortar and sufficient syrup is worked into them, by a light rubbing with the pestle, to cause the powder to form into granules. This will occur before the mixture is moist enough to form a mass, and the mixture should not be kneaded heavily as in pill-making. When the proper quantity of excipient has been incorporated, the moist mixture is pressed through a No. 20 sieve, collected in shallow trays or on a sheet of paper, and dried at a low temperature in an oven or on a radiator. When dry it is advisable to again sift, and to regranulate any very fine or very coarse portions.

The drying is an important consideration. If the powder is left slightly moist and sticky, it will adhere to the machine and make trouble by adhering to the dies or by feeding irregularly. Hygroscopic substances particularly, should be very thoroughly dried. On the other hand, if the granules are too dry, they will not cohere well, and the tablets will crumble easily. In general, there is more likelihood of too little than too much drying.

If the syrup does not impart sufficient adhesiveness, a little gum or sugar may be necessary. Many formulas direct the addition of 10 per cent. of sugar and 5 per cent. of gum to such powders, but the addition of so much sugar is usually unnecessary. If gum is used, white dextrin is preferable to acacia because it makes a more soluble tablet. In the majority of instances gum will be found not necessary, with syrup as an excipient.

Glucose is sometimes directed in minute quantities, mixed with the syrup, to impart adhesiveness. It is liable to cause a spotting of the tablets which makes them unsightly, and it makes tougher and less soluble tablets.

Resinous substances are granulated with alcohol. Some also prefer alcohol or a mixture of three volumes of alcohol with one volume of water, for moistening in general. In such cases some sugar or gum is needed in the material to be granulated.

A fine powder may be mixed with a granular substance and good tablets formed from the mixture **provided the fine powder does not exceed one-third** the total weight of the mixture. Thus tablets of potent drugs, with sugar or milk-sugar as a base, can be made without special granulation, by mixing the potent drug, in fine powder with at least twice its weight of granulated diluent, and compressing the mixture. Owing to the difficulty of mixing the two thoroughly in this form, it is not advisable to attempt this in all cases.

Success in tablet-making depends in large measure upon the condition of the material, and too much care cannot be exercised in securing a proper granulation.

To prevent the tablet-material from sticking to the machine when compressed, some lubricant may be necessary. Many substances compress well without any lubricant, but hygroscopic substances are often troublesome in this regard. Much depends upon the dryness of the material. If the granules are left slightly moist they will stick to the machine, and a further drying may remedy this.

The Lubricants commonly used are **paraffin oil, talcum and boric acid.** The first must be used very sparingly, especially on soluble tablets, a drachm to a pound of material being the usual limit. It is best applied dissolved in about 50 parts of ether, and is sprayed on from an atomizer, then the powder is spread out and the ether allowed to evaporate. Vaseline or petrolatum may be employed in place of the liquid oil. But if either be used too freely the oil will show when the tablet is dropped into water. In cases when ether would soften or dissolve the material, the lubricant is applied without dilution, being added to a portion of the powder, and when well distributed through, this is mixed with the rest.

If the oil is not sufficient in the above proportion, a little talcum may be added. Talcum is objectionable for tablets which are intended to be dissolved, because it makes a cloudy solution, but it is effective and is employed in troublesome cases in spite of its insolubility. As much as a grain per tablet has been employed. It is, of course, advisable to use as little as will do the work.

Boric acid is preferred for soluble tablets because it is soluble. It is not so effective as talcum, and must either be used in larger proportion, or be combined with talcum. As a rule combinations of talcum and boric acid are better than the latter alone, except in cases of hypodermic tablets where a crystal-clear solution is necessary.

Lycopodium may also be used for colored tablets, but its use is very limited.

The rule has been made that not more than 3 per cent. of talcum or 2 per cent. of boric acid, or 1 per cent. of lycopodium should be used. This rule will apply in many cases, but all rules have their exceptions. The most sparing use of lubricants is always in order, and it will be found that a thorough distribution of a small quantity will do quite as much good as a large quantity imperfectly mixed.

In adding lubricants, be careful not to break the granules. The granulated material is put upon a large sheet of paper, or in a dish, the lubricant sprinkled upon it and then worked in by means of a spatula or wooden shovel.

Cacao Butter.—An English pharmacist, Mr. E. White, has suggested cacao butter to serve the double purpose of a granulating and lubricating material. The powders are granulated by mixing with cacao butter under proper conditions, then compressing.

He suggested first a mixture of one part of cacao butter and three parts of starch, this to be mixed with the powder in the proportion of 1 part of excipient to 3 to 5 parts of powder, preferably warm. Later an emulsion of cacao butter was recommended, made by dissolving 5 parts of soap or acacia in 25 parts of *hot* water, and adding 25 parts of melted cacao butter. This is well shaken until the butter is emulsified, then 0.5 parts of powdered tragacanth and 0.5 parts of benzoic acid are added and well shaken in. Finally enough warm water is added to make the whole weigh 100 parts, and the agitation continued until the mixture is creamy. This emulsion is added to the material previously mixed with 5 to 10 per cent. of sugar, in the proportion of 1 part of emulsion to 5 to 7 parts of powder. The mixture is rubbed through a coarse sieve, dried without heat, again sifted, and then compressed.

For substances which are very soluble in water, as opium, aloes, pepsin, vegetable extracts, etc., a solution of cacao butter in ether and alcohol is better. This is made by dissolving 1 part of the butter in 5 parts of ether, and mixing this solution with an equal volume of alcohol at the time of use. This is employed in the same manner and proportions as the butter.

Tablets made with cacao butter are usually a little colored, and unless care is taken in the mixing they may be spotted. They are not as hard as tablets which have been granulated with syrup, and in the author's experience the butter is not always a success as a lubricant.

The difficulty appears to be that the cold butter fails to act well as a lubricant, and the tablets lack smoothness. It also lacks adhesiveness when cold, and more pressure is necessary, but the tablets still crumble easily. Since the method requires quite as much time as the older method of granulating and subsequent lubrication, its advantages are not apparent.

TO SECURE SOLUBLE OR MEDICINALLY ACTIVE TABLETS, the tablet must either dissolve readily in water, or fall into a powder shortly after being dropped into water. The solubility of the tablet will depend, after the question of the solubility of its ingredients, upon its hardness, and upon a sparing use of lubricants. A very hard tablet will dissolve slowly, and an excess of oil in the tablet will hinder solution.

For bodies which are insoluble in water, some means of forcing them apart when they are dropped into water is necessary. There are two ways of accomplishing this. First to mix with the insoluble powder a small quantity of a mixture of bicarbonate of sodium and citric or tartaric acid, so that when the tablet is dropped into water an effervescence takes place within the tablet, thus breaking it up and forcing the tablet into powder. This method is preferred in hypodermic tablets, and in cases where a clear solution finally occurs. But a very slight proportion of effervescent material is needed.

For such substances as acetanilid, bismuth subnitrate and other insoluble chemicals, starch is employed. Starch is a very hygroscopic substance, and absorbs about one-third its weight of water in a moist atmosphere without appearing wet. If then starch be dried thoroughly at a temperature of 100° C. it will swell without gelatinizing or dissolving when immersed in cold water. Advantage is taken of this fact to make **disintegrating tablets**. The powder is granulated as usual and dried. Immediately before compressing, starch, just dried at 100° C., is added so that each tablet will contain 15 to 20 per cent. (or ½ to 1 grain) of the dry starch. The mixture is then compressed. When these tablets are dropped into water the starch swells immediately and the tablet falls to powder. They must be kept in well closed containers, or they will gradually absorb enough moisture to prevent disintegration.

This treatment is advisable for tablets of all insoluble materials which do not swell in water. Vegetable powders will, of themselves, gradually swell in water and disintegrate, and additional treatment is not needed for these.

Manipulation in Specific Cases. — It is manifestly impossible to give in detail the directions for making all kinds or combinations of medicinal agents into tablets. As in other forms of medication, a knowledge of the properties of the material, judgment in handling, and some experience is needed to turn out perfect tablets.

The following classification, and the formulas which follow will illustrate the methods of dealing with the various agents, and will suggest the manipulation for others.

Soluble Salts. — These are mostly crystalline, and can be easily secured in a granular condition. If the crystals are too large they may be ground coarsely in a mill, then sifted, to separate any fine powder, and any large crystals which may have escaped the milling. Non-deliquescent salts are then compressed without any further treatment.

Non-crystalline soluble salts like bicarbonate of sodium, salicylate of sodium, etc., must be mixed with about 10 per cent. of sugar and 5 per cent. of white dextrin and granulated with diluted alcohol. In mixtures these may require to be granulated by themselves and the granules mixed.

Deliquescent salts may be troublesome. They must be well dried before putting into the machine, and if they are very deliquescent, granulation with acacia may be needed. In this case the salt is dried, powdered finely, mixed with one-twentieth or one-fortieth its weight of powdered acacia, moistened with enough water to granulate it, sifted and again dried. As a rule, salts which require this treatment are considered unsuitable for tablet form, and the operation is therefore rarely required. It should also be borne in mind that deliquescent salts may corrode the dies, and the machine needs special protection from them.

Efflorescent salts, when compressed alone, need only to be in a good granular condition. When they are combined, the heavy pressure may start a reaction, and to prevent this they may require to be dried and granulated with syrup as other powders. This is necessary only when the pressure needed to form the tablets squeezes out enough water to start the reaction, or to spoil the appearance of the tablet.

Reducible salts, such as silver nitrate, potassium chlorate, potassium permanganate, etc., may be compressed alone but should not be mixed with organic matter. They are crystalline, and offer no difficulties if compressed alone. If they are to be diluted, inorganic vehicles as kaolin (for tablets not intended to be dissolved) or dried sodium sulphate, magnesium sulphate, etc. (for soluble tablets), should be used as the diluent.

The sugar in the syrup needed to granulate may be disregarded in this case. Or if the active agent is in small proportion it may be distributed in fine powder over the granulated diluent, and then compressed.

Incompatible salts when combined in tablets often need to be protected. In combinations like lead acetate and zinc sulphate, wherein the salts contain water of crystallization, the salts must be desiccated and granulated separately, else the pressure of the dies will liberate the water of crystallization and produce a pasty mass instead of a smooth tablet.

Effervescing tablets are best made by granulating the alkali and acid separately, the other ingredients being mixed with either or divided between the two, as is most convenient. It is possible to make these by granulating the complete mixture with alcohol and drying quickly and thoroughly, but this method requires more skill and care, and good drying facilities. They need special caution in lubricating, since citric and tartaric acid are hygroscopic and tend to stick. The drying is an important factor in these.

Mercury salts are easily reduced by contact with metals when wet, and are liable to be discolored by sifting the damp mass through a metallic sieve. It is better to granulate these by a careful adjustment of the excipient, dry without sifting, then sift when well dried. Unless well dried, the dies may cause a discoloration.

Insoluble Chemicals. — These need more sugar, as a rule, than what would be incorporated by moistening with syrup, to cause them to granulate and cohere well. They may be mixed with one-tenth their weight of powdered sugar and granulated either with syrup or with diluted alcohol and well dried. Just before compression some freshly-dried starch should be distributed through the granules to cause the tablets to disintegrate when dropped into water. One-half to one grain of dry starch per tablet of 3 to 5 grains is the quantity usually required. If a lubricant is needed it should be added to the granulated material before the starch is mixed in. The compression should be as light as will form a tablet with this class.

Bodies belonging to this class are acetanilid, antipyrin, bismuth salicylate, bismuth subcarbonate, bismuth subnitrate, chloralamid, cinchonindine, phenacetin, quinine sulphate, salicin, salol, sulphonal, sulphur, trional, etc.

Insoluble bodies which are given in very small doses and in dilutions, should be triturated with sugar of milk and the mixture granulated with syrup. The sugar of milk is soluble, and being in excess no starch is needed. It forms a better triturating medium than cane sugar. Examples of this class are arsenous acid, calcium sulphide, calomel, mercuric iodide, mercurous iodide, etc.

Some insoluble bodies like naphthalin which are made into tablets for convenience and not intended for internal administration are simply moistened very slightly with water and compressed.

Light and bulky bodies like charcoal, hygroscopic bodies like powdered pepsin, need a larger proportion of sugar to granulate them, and must be formed into fine granules. Charcoal should be mixed with a quarter of its weight of sugar, and granulated with water. Powdered pepsin should be mixed with an eighth to a sixth of its weight of sugar.

The granulated powder should be fine enough to pass through a No. 60 sieve, because the spongy nature of these bodies makes more resistance to compression and the particles do not cohere as well as more compact substances.

Vegetable substances require more liquid to moisten them in granulating, and must either be granulated quickly or considerable time allowed for drying the granules. A little gum is necessary to impart adhesiveness in some cases. Dextrin is to be preferred.

Tinctures, Extracts and Fluid Extracts. — Tinctures, unless used in quantities small enough to allow of their use as moistening agents, must be evaporated to a small bulk and then so used. Frequently an equivalent quantity of the corresponding fluid extract can be substituted for the tincture and evaporation thus avoided. If no other medicinal agent is directed in the tablet, starch, licorice, sugar of milk, or other absorbent body must be employed.

These may also be necessary as adjuncts to other powders in compound tablets. Fluid extracts are treated in the same way as tinctures.

Extracts are softened by trituration with a suitable menstruum to a semifluid consistency, then this is used as the moistening agent. Tablets containing any large proportion of extractive matter may need to be lubricated well to prevent sticking. They also need special care in drying.

Gum resins, oleo resins, resins, etc., may be granulated by grinding coarsely. If the powders are employed they should be moistened very cautiously with alcohol, and dried at a low temperature. They need no lubricating agent, and form smooth and firm tablets very easily as a rule.

Volatile oils, etc., must be absorbed in some dry media. They are best distributed through the other material previously granulated. If the oil is in small proportion it may be dissolved in ether before mixing with the granules, then the latter is dried at a low temperature. Oils act as lubricants, and there is usually no need of further lubrication.

Creosote is directed to be absorbed in starch or licorice, allowed to stand for an hour or so, then add sugar and granulate with three-quarters alcohol. It may also be distributed over the solids previously granulated.

Alkaloids and Potent Principles. — These are usually triturated with sugar of milk for tablets. They present no difficulties, and no gum is needed. Beside alkaloids such bodies as aloin, podophyllin, digitalin, arsenous acid, etc., are so treated.

Hypodermic Tablets. — These should be made with finely powdered cane sugar, moistened with alcohol to granulate, and thoroughly dried. Lubricate with 1 per cent. of boric acid, if necessary, and avoid petrolatum or paraffin oil. Compress as lightly as possible. The usual quantity of sugar employed is one-half grain per tablet.

DIFFICULTIES.

The common difficulties in compressed tablet-making are (1) crumbling, (2) chipping, (3) sticking to the dies, (4) discoloration and (5) insolubility.

Crumbling may be due to insufficient pressure, or to a lack of adhesiveness. If from the latter cause, the granules may be too dry or the substance may be deficient in adhesive qualities.

Moistening the granules *very slightly* with water, preferably by spraying with an atomizer, will correct the former. The moistening should be very slight, and not enough to make the granules appear moist. If the substance is insoluble, and dry starch is needed to make the tablets disintegrate, moistening the granules will destroy the disintegrating power of the starch, and the following remedy should be employed.

If crumbling is due to a lack of adhesiveness, this is best remedied by the addition of sugar and gum. The granules may be sprinkled lightly with a mixture of two parts of finely powdered sugar and one of white dextrin. If this does not suffice, regranulation with ten to twenty per cent. of the starch-dextrin mixture may be necessary. In very obstinate cases the use of a little acacia, 1 to 3 per cent., may be needed, but acacia should be avoided if possible.

Chipping, or the breaking off of a thin film from the surface of the tablet, is usually due to excessive pressure, and is more likely to occur in thick than in thin tablets. All materials are somewhat elastic, and in a thick tablet the surfaces are compressed harder than the center, hence a skin is formed which is harder than the interior of the tablet, and it tends to break away. Diminishing the pressure, or changing the dies (to make a larger-sized tablet) will usually remedy this difficulty.

Sticking to the dies is, obviously, due to an excessive stickiness in the material. It is often caused by moisture in the granules, particularly when deliquescent or hygroscopic substances are present. Further drying the granules will help, if not entirely remedy, this difficulty. This is the first remedy to be tried in all such cases.

Lubricants are also needed in the majority of cases. The choice and use of lubricants calls for discrimination. Paraffin oil is the most effective lubricant. It must be used very sparingly, or it will show in the water in which the tablet is subsequently dropped. Or it may even make a greasy surface on the tablets. A combination of lubricants is needed in very difficult cases. After the limit of paraffin oil has failed to prevent sticking, talcum must be added. And if an excessive amount of talcum is also required, boric acid may also be used, particularly for soluble tablets.

All this suggests that sticking is sometimes a very troublesome difficulty. This is the case. But like most difficulties in work, the best remedy lies in beginning right. Proper granulation and drying of the materials will accomplish more than all else in preventing subsequent trouble. Then a judicious choice and use of lubricants will solve all problems.

Paraffin oil works best when added last.

Discoloration may be due to imperfect mixing of oily materials or of saccharine substances. It is shown by spots on the surface of the tablets which are irregular and uneven. A more thorough mixing is, of course, the remedy for this.

Discoloration is also caused by excessive pressure, the oil being squeezed out of oily drugs, or when an oil is an ingredient of the tablet, too much pressure forces it to the surface. Reducing the pressure is the remedy, unless an excessive quantity of oil is present. Then it may be necessary to make a larger tablet, using a vegetable absorbent preferably, to better absorb the oil.

Insolubility or inactivity of tablets depends, of course, more upon the character of the ingredients than upon the condition of the tablets. But since all kinds of substances are incorporated in tablets, and all are expected to be medicinally active, the condition of the tablet must be as favorable to solubility or disintegration as possible.

Too much pressure, an excess of gum, particularly acacia, and excessive lubrication all tend to hinder medicinal activity in the tablet.

If starch is employed as a disintegrating material, it must be thoroughly dry at the time the tablet is made. Otherwise it is useless for this purpose.

TRITURATE TABLETS.

Triturate tablets or tablet triturates are made of fine powders in a moist condition. They are an American idea, having been introduced by Dr. Robert Fuller, of Philadelphia.

They are very small and comparatively thick lozenges, differing from troches in being easily crushed, and containing no gum, and from compressed tablets in being diluted medicinal agents, and in being made from very fine powders.

They are especially adapted for the administering of very powerful remedies, or such as are given in very small doses, such as strychnine, morphine, narcotic extracts, etc. They are used either as substitutes for pills, when, if properly made, they act more promptly, or for making solutions. They should quickly dissolve or fall into powder when dropped into water. Bulky medicines are seldom adapted to triturate tablets, but tinctures and fluid extracts are sometimes used in this form.

They are made in moulds, consisting of a plate of hard rubber or metal, having the thickness of the desired tablets (usually ⅛ to ¼ inch) and perforated with 50 or 100 holes having the diameter of the tablets. Another plate has a corresponding number of projecting pegs which fit into these holes, and serve to eject the tablets after they are moulded. Each time the mould is filled, 50 or 100 tablets are made.

In making the tablets, two things are necessary beside the medicinal body and the mould; (1) a suitable diluent, in powder form, and (2) a proper moistening agent.

Diluents. — The term tablet triturates came from the first tablets of this kind which were made from *triturations*, *i. e.*, combinations of potent medicines with sugar of milk, made by trituration, the sugar of milk serving as a diluent. For a time sugar of milk served as the only diluent, but as special qualities in tablets were demanded, other diluents came into use to supply these. The diluents now used are (1) milk sugar, (2) cane sugar, (3) mixtures of milk and cane sugar, and (4) kaolin or precipitated chalk.

The choice of diluent depends upon the character and use of the tablet, and usually is not a matter of great importance. Kaolin or precipitated chalk is only employed for chemicals which would be changed by contact with sugars, such as silver nitrate and potassium permanganate.

Sugar of milk will serve in almost every other case except when a hypodermic tablet is desired, when it is required to dissolve quickly and in a very small quantity of water. Cane sugar is more soluble than milk sugar, and hence makes a more soluble tablet. Aside from this, cane sugar makes a harder tablet than does milk sugar, and is sometimes preferred for this reason.

The aim in tablets is to get a tablet that will bear handling and the ordinary attrition of bottling without losing any of its form, and yet will crush easily in the fingers. So when milk sugar will make, alone, a tablet which crumbles too easily, a combination of the two sugars will secure a firmer tablet.

Or if cane sugar alone makes too hard a tablet, a small proportion of sugar of milk will prevent hardening, and possibly make a more quickly soluble tablet. So E. S. Anderson prefers to make most of his tablets of a mixture of five parts of milk sugar with one of cane sugar, as making a harder and less friable tablet than milk sugar alone. And for similar reasons, some prefer to use a mixture of three or four parts of cane sugar with one of milk sugar for hypodermic tablets. But *good tablets* can be made with either sugar alone.

An essential quality in any diluent is that it should be in a very fine and even powder. Nothing coarser than a number 120 powder should be used, and finer powders than this will make smoother tablets. It may be stated as a rule that the finer the powders the smoother the tablets. Tablet manufacturers always sift the diluents before using, to insure this.

Moistening Agents. — The appearance and wearing qualities of the tablets depend, next to the fineness of the diluents, upon the use of the moistening agents. The choice of a moistening agent is comparatively simple — *it should exert a very slight solvent action upon the mixed material of the tablet.*

This is similar to a pill excipient, but for tablets the moistening agent is a thin mobile fluid and need not impart so marked an adhesive or plastic quality as is required in pill excipients.

The moistening agents in common use are (1) alcohol, (2) absolute alcohol, (3) water, (4) mixtures of alcohol and water, and (5) chloroform, or mixtures of chloroform and alcohol.

When the greater bulk of a tablet consists of milk or cane sugar, alcohol serves well as a moistening agent. But if the greater bulk consists of a resinous body, or of an insoluble salt possessing no adhesive quality, or of any substance which is very soluble in alcohol, water is a better moistening agent. In these cases, alcohol would soften the resinous or soluble mass too much, and for the insoluble salt water is needed to develop a full adhesiveness of the sugar and hold the tablet together.

But just as in the ordinary tablet, alcohol tends to make a more friable, and water a harder tablet, so in some instances a mixture of the two strikes a better medium. Mr. Anderson prefers a mixture of 22 parts of alcohol to one of water for moistening most of his tablets. But more care is necessary in using this than for either alone, and the maker who distrusts his skill will be safer with alcohol alone, though his tablets may not wear as well.

Absolute alcohol is only needed for moistening tablets containing very deliquescent bodies, or when water would bring about an undesired reaction, as in a Blaud tablet, or when solution of the medicine should be avoided for any reason, as in apomorphine tablets, in which water would develop a green color.

Chloroform is employed for similar purposes as absolute alcohol, and for the same reasons. Chloroform alone, or a mixture of chloroform and alcohol (which evaporates more slowly) may be used as a substitute for absolute alcohol. Benzine has been suggested for similar purposes, but it is difficult to get rid of the odor.

But more important than the kind, is the amount of the moistening agent to be used. The powders must be thoroughly dampened, but must not be pasty. The mass, when pressed into the molds, must be moist enough to take and hold the form of the molds, but not enough to show liquid on the surface. The wetter the mass, the more compact and the harder will be the tablets. If not wet enough the tablets will crumble easily. If too wet, they will be hard.

The mass should be moist enough so that when the molds are filled, the surface of the tablets will be smooth and free from cracks. On the other hand, if it is too wet, liquid may show on the surface, and when the tablets are dried they shrink and present a concave surface, or even crack open. An over-moist mass is also likely to stick to the mould, while one moistened just right, comes out easily.

In rare instances, when there is too little sugar in the mixture to impart sufficient adhesiveness, and the moistening agents do not act well with the medicinal body, a stiff starch paste has been employed as a moistening agent. This can be used a little more freely than the limpid moistures. Gum solutions should be avoided, as they make too hard a tablet.

In making tablets some calculation, and usually a trial lot, is necessary to insure the accurate quantity of medicinal agent in each tablet. The molds should first be tested, by filling with milk sugar, properly moistened, and the resulting tablets thoroughly dried and weighed. This gives the capacity of the mould in milk sugar alone. It is well to ascertain its capacity in cane sugar also. A trial lot of tablets is then made as follows: The medicinal ingredients are weighed and also the sugar for 50 (or 100) tablets. A portion of the sugar equal in bulk (as accurately as can be judged) to the medicinal ingredients is then set aside, and the rest is mixed, moistened and filled into the mold. If all the holes are filled, and none of the mass is left, by weighing the sugar which was set aside, the amount used can be ascertained and a formula made up for any number of tablets. If there is any mass in excess, it indicates that too much sugar was used, and the excess should be dried, weighed and added to the sugar just set aside, to calculate the quantity which should have been used. If the mold is not completely filled, by counting the unfilled molds, the additional quantity of sugar needed is readily calculated, and the whole may be re-massed and again tried. Formulas which have been worked out in this way should be recorded for future use.

If a large quantity of one kind of tablets is to be made the triturated mixture should be moistened in portions, only sufficient for a few minutes' filling of the mold being moistened at a time, lest it dry too much.

After the tablets are removed from the mold they must be thoroughly dried. Colored tablets are now liable to become streaked unless dried evenly. A sieve, or a thin cloth stretched upon a frame, should be employed, so that the tablets will dry upon all sides alike. If dried on a hard impervious surface, the upper surface of the tablet will dry first and the color will be deeper there than at the bottom. If only a few tablets are to be made, they may be dried on blotting-paper, which absorbs the moisture from the under surface. All tablets must be thoroughly dried before bottling or they may mould.

When the molds are filled, both sides should be smoothed off with the spatula, and if the mass is at all sticky, both surfaces should be dusted with a little of the dried mixture, or a suitable dusting-powder before ejecting. Vegetable extracts usually make a sticky mass, and the extract should not exceed one-third the weight of the tablet. It is frequently necessary to dust the molds with lycopodium or other powder before filling in order to secure smooth tablets. Fluid extracts and tinctures, when not exceeding three-fourths of a minim per grain of mass, can be incorporated as moistening agent without evaporating. When the quantity exceeds this proportion, they must be evaporated before mixing.

Hypodermic tablets must be moistened as little as possible, in order to secure a porous and friable tablet which will dissolve quickly. A glass plate is the best surface on which to make tablets, and the mould should be slid off rather than lifted up, when filled.

A special tablet spatula of horn, with a very broad and short blade, similar to a putty-knife, is best for filling the moulds. It is more springy than a steel spatula, and it never discolors the tablets.

Many commercial tablets which are labeled "tablet triturates" are in reality compressed tablets. The composition of these is essentially the same, and the pressure is the lightest. The reason for making them by compression, is that when the power and machinery is at hand it is cheaper to utilize them in making tablets one at a time, than to let them remain idle while an operator spends his time making tablets 100 at a time. Also that many mixtures are less troublesome to compress in a dry and granular condition than to mould in a moist condition.

Tablet saturates are plain tablets of sugar of milk which are saturated as wanted, with an alcoholic tincture or fluid extract and again dried. These correspond to the homeopathic pellets of sugar which are medicated in the same way. The tablets can be kept in stock, and medicated at short notice, but they cannot be medicated with aqueous, or weakly alcoholic fluids.

If a tincture is weak in alcohol it will make the tablets sticky and shapeless when poured upon them. The fluid extract of the same drug may be diluted with strong alcohol and used in its place.

TABLETS.

A. Compressed Tablets.

229.

Potassium Chlorate.

Potassium chlorate, granulated	200 gr.

Make 100 tablets.

Compress in the machine.

230.

Potassium Chlorate and Muriate of Ammonia.

Potassium chlorate, granulated	250 gr.
Ammonium chloride, granulated	250 gr.

Make 100 tablets.

Mix thoroughly on paper with a spatula, and compress.

231.

Quinine Bisulphate, 2 gr.

Quinine bisulphate, crystals	200 gr.

Make 100 tablets.

Lubricate with paraffin oil; dry, weigh and compress.

232.

Ammonium Chloride and Licorice.

Ammonium chloride, powdered	200 gr.
Extract of licorice, powdered	800 gr.
Oil of anise	5 drops

Make 100 tablets.

Mix the powders, granulate with water, dry, add the oil of anise dissolved in ether, and a little paraffin oil, dry, weigh and compress.

233.

Alum Compound.

Dried alum	175 gr.
Zinc sulphate	200 gr.
Morphine sulphate	4 gr.
Hydrastine muriate	4 gr.

Make 100 tablets.

Mix the powders, add 40 gr. of sugar, granulate with syrup, dry, add 5 gr. of boric acid and a little paraffin oil, weigh and compress.

234.

Quinine Tablets, 2 gr.

Quinine sulphate	200 gr.

Make 100 tablets.

Mix the quinine with 20 gr. of sugar and 10 gr. of dextrin, granulate, lubricate with paraffin oil, dry, mix in 25 gr. of dried starch, weigh and compress.

235.

Tasteless Quinine, 3 gr.

Quinine tannate	300 gr.
Powdered chocolate	300 gr.
Powdered sugar	100 gr.
Saccharin	4 gr.

Make 100 tablets.

Mix, granulate with water, lubricate with 25 gr. of talcum, weigh and compress.

236.

Phenacetin Tablets, 3 gr.

Phenacetin	300 gr.

Make 100 tablets.

Mix the phenacetin, in fine powder, with 30 gr. of sugar and granulate with syrup. Lubricate the dry granules with paraffin oil, shake in 50 gr. of dried starch, and compress.

237.

Acetanilid and Soda Tablets.

Acetanilid, powdered	250 gr.
Sodium bicarbonate	250 gr.

Make 100 tablets.

Mix the powders with 50 gr. of powdered sugar and 20 gr. of white dextrin, and granulate. Lubricate the granules with paraffin oil, shake in 25 gr. of dried starch, and compress.

238.

Headache Tablets.

Acetanilid	350 gr.
Sodium bicarbonate	100 gr.
Caffeine	50 gr.

Make 100 tablets.

Mix with 25 gr. of powdered sugar and 25 gr. of white dextrin, granulate with syrup or water, lubricate with paraffin oil, shake in 40 grs. of dried starch, weigh and compress.

239.

Sulphur and Cream of Tartar.

Powdered sulphur	500 gr.
Cream of tartar	500 gr.

Make 100 tablets.

Mix the powders with 50 gr. of powdered sugar and 50 gr. white dextrin, granulate with syrup, dry, add 50 gr. dried starch, weigh and compress.

240.

Bismuth and Soda.

Bismuth subcarbonate	300 gr.
Sodium bicarbonate	200 gr.

Make 100 tablets.

Mix with 50 gr. of sugar and 50 gr. of dextrin, granulate, dry, lubricate with paraffin oil, shake in 25 gr. of dried starch, and compress.

241.

Calomel and Soda.

Calomel	100 gr.
Sodium bicarbonate	100 gr.

Make 100 tablets.

Mix with 20 gr. sugar and 20 gr. of dextrin, granulate, lubricate with paraffin oil, and compress.

242.

Iron Quinine and Strychnine.

Soluble iron phosphate	200 gr.
Quinine sulphate	100 gr.
Strychnine sulphate	1⅔ gr.

Make 100 tablets.

Mix all with 25 gr. powdered sugar, granulate, lubricate with paraffin oil, and compress.

243.

Saccharin.

Saccharin	10 gr.
Sodium bicarbonate	9 gr.

Make 100 tablets.

Mix with 90 gr. sugar of milk and 10 gr. dextrin, granulate and compress.

244.

Effervescing Lithia.

Lithium citrate	300 gr.
Sodium bicarbonate	260 gr.
Potassium bicarbonate	550 gr.
Citric acid	550 gr.

Make 100 tablets.

Mix the bicarbonates with 80 gr. of dextrin, granulate with syrup, and dry well. Mix the acid and lithium citrate, granulate with syrup and dry well. Mix the granules, lubricate with paraffin oil, stir in 100 gr. of talcum, weigh and compress.

245.

Effervescing Lithia.

Lithium citrate	300 gr.
Sodium bicarbonate	300 gr.
Tartaric acid	275 gr.

Make 100 tablets.

Mix the sodium bicarbonate with 150 gr. sugar and 15 gr. of dextrin, granulate with syrup and dry well. Mix the acid and lithium citrate and granulate with syrup. Mix the granules, lubricate with paraffin oil and talcum, and compress.

246.

Soda Mints.

Sodium bicarbonate	400 gr.
Oil of peppermint	20 min.

Make 100 tablets.

Granulate the soda with 40 gr. of sugar, and 20 gr. of dextrin, moistening with water. Mix the oil with the dried granules and compress lightly.

247.

Rhubarb and Soda.

Powdered rhubarb	200 gr.
Sodium bicarbonate	200 gr.
Oil of peppermint	11 min.

Make 100 tablets.

Mix the powders with 50 gr. of sugar and 25 gr. of dextrin, moisten with syrup and granulate. Mix the oil with the dried granules and compress.

248.

Opium, 1 Gr.

Powdered opium	100 gr.

Make 100 tablets.

Mix the opium with 25 gr. of sugar, granulate with alcohol, dry and compress.

249.

Aloes and Myrrh.

Aloes	200 gr.
Myrrh	100 gr.
Aromatic powder	50 gr.

Make 100 tablets.

Mix well, granulate with ¼ alcohol, dry at a low temperature, and compress.

250.

Creosote.

Creosote	100 min.

Make 100 tablets.

Mix the creosote with 50 gr. of powdered licorice, let stand an hour, add enough sugar to make a granular mass and compress.

251.

Dover's Powder.

Dover's powder	500 gr.

Make 100 tablets.

Granulate with syrup, dry and compress.

252.

Aloin, Strychnine and Belladonna.

Aloin	60 gr.
Strychnine	1 gr.
Ext. belladonna	15 gr.

Make 60 tablets.

Mix the aloin and strychnine with 60 gr. of sugar. Soften the extract with diluted alcohol and mix with powders, adding enough more water to granulate. Dry at a low temperature, lubricate with paraffin oil and talcum, and compress.

253.

Pepsin Tablets.

Scale pepsin	100 gr.

Make 100 tablets.

Rub the scales through a No. 30 sieve, lubricate with paraffin oil and compress.

Or, mix 100 gr. of powdered pepsin with 20 gr. of sugar, moisten with diluted alcohol, granulate through a No. 60 sieve, dry, lubricate and compress.

254.

Pepsin and Bismuth.

Pepsin	100 gr.
Bismuth subnitrate	500 gr.

Mix with 600 gr. of sugar, granulate with syrup, dry well and lubricate with oil. Shake in 50 gr. of dried starch and compress.

255.

Santonin and Calomel.

Santonin,	
Calomel,	
Cocoa,	
Sugar	of each 100 gr.

Make 100 tablets.

Granulate with syrup, and compress.

256.

Charcoal, 5 Gr.

Powdered charcoal	500 gr.

Make 100 tablets.

Mix with 125 gr. sugar and 25 gr. dextrin, moisten with syrup, granulate through a No. 60 sieve, dry well and compress.

257.

Strychnine, 1/60 Gr.

Strychnine sulphate	1⅔ gr.
Sugar of milk	100 gr.

Make 100 tablets.

258.

Hypodermic Morphine, ⅛ Gr.

Morphine sulphate	12½ gr.
Sugar	75 gr.
Sugar of milk	12½ gr.

Make 100 tablet triturates.

Dovers P.

Ipecac.
Opium
Lac.

CHAPTER X.

POWDERS, SPECIES, CACHETS, CAPSULES, WAFERS.

Species (Lat. *specie-um*). — Very coarsely powdered or merely bruised drugs, intended for the domestic preparation of infusions or decoctions. They are also called "*teas*," as "Breast-tea," "physic-tea," etc.

Powders (Lat. *pulvis-eris*, plural *pulveres-um*).—Applied to drugs and chemicals administered in the dry powdered form. When divided into doses powders are administered as, —

Papers (Lat. *chartulæ-arum*). — Small folded papers each containing a single dose.

Capsules (Lat. *capsulæ-arum*). — Ovoid, or short cylindrical, shells of gelatin, usually in two close-fitting parts, in which powders, pastes, or liquids are enclosed.

Cachets (Lat. *capsulæ amylaceæ*).— Small concavo-convex discs made of flour or starch and gum, the two parts of which, when fitted together and cemented by moistening, form a receptacle for powders. When swallowed, they are softened by dipping into water.

Wafers (Lat. *chartulæ amylaceæ*).— Small sheets resembling powder-papers, composed of flour or starch and gum, in which, after moistening, powders are folded in the same manner as in papers. These are softened before being swallowed by dipping into water.

The effect of certain medicines upon the system is due to a considerable extent to the form in which they are administered.

If a teaspoonful of dry salt (sodium chloride) be placed upon the tongue and slowly swallowed, it checks hemorrhage of the lungs; but the same amount of salt dissolved in a teacupful of warm water is a prompt emetic.

The alkaline bromides, given in dilute solution, allay excitement, but if swallowed dry they irritate the stomach and anything but a quieting effect is produced.

Bismuth salts owe their efficiency in a measure to mechanical action, and produce better results when administered in powder form or in mixtures than in solutions.

Hence **the administration of medicines in powder form** is not only a matter of convenience to the patient, or because of insolubility, but oftentimes because of certain peculiar actions upon the system. The bodies which are most frequently prescribed in powders are those which are insoluble in the ordinary solvents, and are too bulky for administration in pills, or when a greater diffusion is desired than can be obtained in pills or tablets.

Thorough diffusion of some drugs and chemicals seems to modify and increase their action. This is illustrated in the official Dover's powder.

The prolonged trituration which is necessary to reduce the coarsely powdered sugar of milk to a fine powder, comminutes and thoroughly diffuses the ipecac and opium, and the resulting mixture possesses materially different medicinal properties from a corresponding mixture, the ingredients of which are mixed in a crude or "easy" way. Calomel is another of those bodies which act the better the more finely it is powdered, and (within certain limits) the more thoroughly it is diffused.

Such bodies should always be triturated in a mortar.

The dispensing of prescriptions calling for powders, then, demands some knowledge of the therapeutic action of drugs and their physical characteristics, in order to intelligently interpret the physician's desires.

Less observation of incompatibilities is demanded than in most other forms of medication, since chemicals do not readily react in the absence of moisture, and many salts may be administered commingled in powders which could not be combined in liquids or moist solids.

Powders are mixed in three ways: by trituration in a mortar, by stirring with a spatula on paper, and by sifting.

The choice of methods should not be altogether a matter of convenience, but should be governed by the results.

The mortar method is better when pulverization and thorough diffusion is desired, but it gives a more compact powder than sifting.

Light powders, snuffs, insufflations, etc., are best mixed by sifting, when the powder is not compacted and diffuses more readily when thrown into water or in the air. Powders containing magnesia are most conveniently mixed on a sheet of smooth paper, or by sifting. If triturated heavily in a mortar it is pressed into a heavier condition, and subsequent sifting does not restore its lightness.

Most vegetable and non-crystalline bodies can be mixed in this way, and the resulting powder diffuses through water more readily than when they are triturated. The sifting should be repeated two or three times, to insure complete admixture, unless combined with stirring on a piece of paper.

A cheap and handy little sieve for mixing small quantities of powders can be constructed from a four-ounce chip ointment box and a small bit of cheese- or bolting-cloth. The top-piece of the cover is removed, leaving only the rim. The cloth is now stretched over the top of the open box and the cover-rim placed in position, so as to hold the cloth in place and leave a part of the rim above. Powders are readily rubbed through the cloth by means of a spatula, and caught inside the box, preferably upon a paper lining, or the bottom of the box may also be removed and the sifted powder caught upon clean paper.

Crystalline salts, even if already powdered, are best mixed by trituration. Wedgwood mortars grow very smooth with use, when powders do not mix as readily in them. A suitable degree of roughness should be occasionally imparted by triturating a little coarse emery in the mortar. Pumice stone, sand, etc., may be used in place of emery, but they are not as quickly effective.

When small quantities of powerful remedies are to be mixed with bulky powders, the potent drug is first placed in the mortar with an equal bulk of its diluent and triturated until well mixed, then a double volume more of diluent is added and mixed before a further quantity is added, so continuing till the end.

In this way completed admixture is assured with a minimum of time and labor, and the dispenser can always feel confident of the homogeneity of the powder.

If the entire amount of diluting-powder is added to the potent drug at once, even a long-continued trituration will not bring this same confidence.

When heavy powders are to be mixed with light ones, the mixing is hastened by placing the heavy powder (when first weighed) on top of the lighter; then upon stirring the heavier powder gradually sinks through the lighter and mixes with it in the process. If placed at the bottom of the mortar or sieve, the entire mixing must be done by mechanical force.

Incompatible salts and those containing water should be mixed lightly, as pressure may start a reaction.

Soluble powders may be dispensed in granular condition or powdered. They are easier divided when in powder.

The following suggestions by Mr. Peter Boa,* on the effects of different methods of mixing powders, may be found useful. He says: "Certain powders when mixed together are very difficult to diffuse in water, though it may happen that each one by itself can be mixed with ease. Again, there are compound powders in which one or more of the ingredients might be immiscible separately, yet when in combination they do not present the same difficulty. The most marked examples of these peculiarities occur when insoluble, inorganic substances are mixed with vegetable powders. The inorganic substances may be diffusible or non-diffusible, and magnesia and sulphur may be taken as types.

"Sulphur does not diffuse in water by itself, but in combination with vegetable powders it may do so with little difficulty.

"Magnesia diffuses readily, but when compounded with certain vegetable powders it forms a powder which persistently floats upon water. Sulphur has, therefore, to be made miscible; magnesia has to be prevented from becoming immiscible. And it is here that the method of mixing may be brought into play, so as to effect the different results which we have in view."

The magnesia is prevented from becoming immiscible by avoiding trituration, hence we mix magnesia powders on paper or by sifting. Sulphur is made miscible by trituration with vegetable powders in a mortar. In cases where both enter into a compound powder, the sulphur may be triturated with vegetable powders, then this mixture combined with the magnesia by sifting or by means of a spatula.

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* Phar. Journ. and Trans., 1881, p. 546.

Sometimes, however, magnesia renders resinous and other bodies which are immiscible with water, more diffusible by trituration with them, and no hard and fast rule can be laid down.

DISPENSING POWDERS. — Powders are dispensed in bulk; in papers (*chartulæ*), in capsules, in cachets, or in wafers.

Powders which are taken in relatively large doses, as a teaspoonful at a time, are dispensed in bulk. If not easily altered by contact with the air, they are placed in a suitable box, which is labelled; but hygroscopic, or changeable powders, granular effervescing salts, etc., should always be dispensed in wide-mouthed bottles.

Sometimes powders which are administered in comparatively small doses are ordered undivided, with the insertion of a sample dose in a separate paper. If a chemical, it should be powdered to destroy its physical identity, and the sample is then carefully weighed, folded in paper in the usual manner, and placed in an envelope plainly marked. This method of dispensing is practiced only in the interests of economy, and is usually eschewed.

Finely powdered drugs should never be used in preparing species, because they make a muddy and disagreeable infusion. The drug should never be finer than a number twenty powder, and in many cases a bruised drug is preferable even to this. The bruising is readily done in an iron mortar. The mixing need not be thorough unless the package is to be divided for the preparation of successive lots of infusion.

Powders which are to be encased in capsules, wafers and cachets, are to be first divided in the usual way. The administration of powders in this form is chiefly for the purpose of disguising the taste, but some protection is also afforded against the action of the air.

The action of air and light upon chemical substances calls for special attention in the dispensing of powders, to avoid undesirable changes in their preparation or subsequently. A list of these are given in the following tables, the most important to be memorized being printed in heavy type.

Salts that absorb moisture from damp air and ultimately become liquid, or DELIQUESCENT SALTS.	Salts that lose moisture in warm and dry air and become pulverulent, or EFFLORESCENT SALTS.
Acid Carbolic.	
" **Chromic.**	
" Citric.	Acid, Citric.
Aluminum Acetate.	
" **Chloride, Bromide and Iodide.**	
Ammonium Nitrate.	Ammonium Phosphate.
" Valerianate.	Barium Acetate.
Antimony Chloride.	

Calcium Chloride, Bromide and Iodide.	Calcium Acetate.
" Chlorate.	
	Cinchonidine Sulphate.
Cobalt Acetate.	Cobalt Sulphate.
" Chloride.	
" Nitrate.	Codeine.
Copper Chloride.	Copper Acetate.
" Nitrate.	" Sulphate.
Gold Chloride.	
Ferrous Chloride, Bromide and Iodide.	**Ferrous Sulphate.**
Ferric Chloride.	Ferric Alum (Ferri et Ammonii Sulphas).
Hyoscyamine Hydrochlorate.	
" **Sulphate.**	
Lithium Chloride, Bromide and Iodide.	
" Citrate.	**Lead Acetate.**
" Salicylate.	
Magnesium Chloride, Bromide and Iodide.	**Magnesium Sulphate.**
Magnesium Acetate.	
" Chlorate.	
Manganese Chloride, Bromide and Iodide.	Manganese Sulphate.
Manganese Nitrate.	
Physostigmine (Eserine) Sulphate.	
Pilocarpine Hydrochlorate.	
Platinum Chloride.	
Potassa.	
Potassium **Acetate.**	Potassium Ferrocyanide.
" **Carbonate.**	**Potassii et Sodii Tartras** (Rochelle Salt)
" Citrate.	
" **Cyanide.**	
" **Hypophosphite.**	
" Sulphite.	**Quinine Bisulphate.**
" Sulphocarbolate.	" Hydrochlorate.
" Sulphocyanide.	" Hydrobromate.
" **Tartrate.**	" **Sulphate.**
Soda.	
Sodium **Hypophosphite.**	
" Iodide.	Sodium Acetate.
" Nitrate.	" Arsenate.
" Nitrite.	" Borate (in warm and dry air).
" Sulphovinate.	" **Carbonate.**
" Valerianate.	" Hyposulphite (above 33° C.).
	" Phosphate.
	" Pyrophosphate.
	" Santoninate.
	" **Sulphate.**
	" Sulphite.
	" Sulphocarbolate.
Strontium Chloride, Bromide and Iodide.	Strontium Acetate.
	" Nitrate.
	Strychnine Sulphate.
Zinc Chloride, Bromide and Iodide.	**Zinc Acetate.**
" Chlorate.	" Sulphate.
" Nitrate.	

Some bodies are **hygroscopic,** *i. e.*, absorb moisture from the damp air, but do not liquefy. Among these are,—

Ammonium Chloride, Bromide and Iodide; the first very slightly so, the last badly.

Amylene hydrate.

Chloral and Butyl Chloral, Chlorinated Lime (very hygroscopic).

Dried Alum, Dried Sulphate of Iron, Dried Carbonate of Sodium, and other exsiccated salts.

Granular effervescing Salts.

Citrate of Iron, Phosphate of Iron, and Pyrophosphate of Iron (in scale form).

Saccharated Iodide of Iron (very hygroscopic).

Pepsin (very hygroscopic).

Sulphuretted Potassa.

Sodium Chloride (slightly), and Bromide.

Sparteine Sulphate.

Other bodies are decomposed, volatilized, or become changed in color and appearance when exposed freely to the action of air and light. Care should be exercised in dispensing such to see that they are in proper condition, and to prevent any subsequent change.

SUBSTANCE.	CHARACTER OF CHANGE.	REMARKS.
Acid, Benzoic	Darkens	By action of strong light.
" Carbolic	Becomes red	No deterioration in value.
Ammonium Benzoate	Loses NH_3	Restored by addition of ammonia water.
" Bromide	Decomposes	" " " "
" Carbonate	"	Loses both NH_3 and CO_2 and finally becomes bicarbonate.
" Iodide	"	Restored by addition of ammonium sulphide (see U. S. P.), or by washing with ether.
" Valerianate	"	Restored by addition of ammonia water.
Apomorphine Hydrochlorate	Becomes greenish	By action of light, rapidly.
Aconitine	" yellowish	" "
Aristol	Decomposes	" "
Arsenic Iodide	Loses iodine	Decomposes very easily.
Bismuth and Ammonium Citrate	Loses NH_3	Restored by addition of ammonia water.
Calcium Hypophosphite	Oxidizes	By action of air.
" Sulphide	"	" "
Camphor	Evaporates	
Chinoline	Decomposes	
Chloral	Volatilizes and becomes acid	
Chrysarobin	Darkens	By action of light.
Cinchonidine Salts	Become brownish	Very slowly by action of light.
Cinchonine Salts	" "	" " "
Europhen	Decomposes	
Ferrous Carbonate, saccharated	Oxidizes and darkens.	By action of air; best kept in the light.
Ferrous Iodide, saccharated	" "	" " " " "
Ferrous Salts in general	" "	" " " " "

Substance.	Character of Change.	Remarks.
Ferric, scale salts . . .	Darken	Become less soluble, by action of light.
Iodides in general . .	Partially decompose	By action of light and air.
Iodoform	Darkens	Loses iodine and volatilizes.
Lead Acetate	Loses acetic acid, and carbonates . . .	Restored by addition of acetic acid.
Lime	Absorbs water, and carbonates . . .	Must be kept in tight containers.
Lime, chlorinated . .	Absorbs water and loses chlorine . .	“ “ “ “
Magnesium Sulphite .	Oxidizes	By action of air.
Mercuric Cyanide . .	Darkens	By action of light.
“ Iodide . . .	Reduced, darkens .	By action of strong light.
Mercurous Chloride .	“ “ .	“ “ “
“ Iodide . .	“ “ .	Reduced rapidly by light, forming metallic mercury and poisonous red iodide.
Mercuric Oxide, yellow	“ “ .	By action of light.
“ “ red .	“ “ .	“ “ very slowly.
Morphine Acetate . .	Loses acetic acid . .	
Potassa, sulphurated .	Oxidizes	By action of air.
Potassium Cyanide . .	Loses CN, and carbonates	“ “
“ Hypophosphite	Oxidizes	“ “ more rapidly if deliquesced.
Pyrogallol	Oxidizes and darkens	By action of air and light.
Quinine Salts	Become brownish .	“ light very slowly.
Resorcin	Darkens	“ air and light.
Santonin	Becomes yellowish .	“ light.
Silver Salts, all . . .	Reduced and darken	Must be well protected from light, and organic matter.
Sodium Santoninate .	Becomes yellowish .	By action of light.
“ Bicarbonate .	Loses CO_2 — reduced to carbonate . . .	By warm air.
“ Bisulphite . .	Loses sulphurous acid	By action of air.
“ Salicylate . .	Darkens	“ strong light, in presence of alkalies.
“ Sulphite . . .	Oxidizes to sulphate	By action of air.
Sulphur Iodide . . .	Loses iodine . . .	“ “
Zinc Acetate	Loses acetic acid . .	Restored by addition of acetic acid.
“ Iodide	Oxidizes and liberates iodine	By action of air.
“ Phosphide . . .	Emits phosphorous vapor	“ “
“ Valerianate . . .	Loses valerianic acid	Restored by addition of valerianic acid.

GRANULAR EFFERVESCING SALTS. — These may be easily and quickly made, to satisfy small special orders, at the prescription counter. The basis of these is a mixture of sodium bicarbonate with citric or tartaric acid and sugar.

When thrown into water the bicarbonate is neutralized, carbonic acid is evolved, causing the effervescence, and a citrate or tartrate of sodium remains in solution, a slight excess of acid being present to give a pleasant acidulous taste.

Citric acid mixtures are easier to granulate than tartaric mixtures, but the latter are less expensive, and are more frequently employed for that reason.

The bicarbonate and acid are used in nearly molecular proportions, *i. e.*, 83.85 parts of sodium bicarbonate to 70 parts of citric acid or 75 parts of tartaric acid. The amount of sugar varies with different mixtures, and may be made to serve as a filling.

All these salts are given in teaspoonful (or multiples of it) doses, and 90 grains (6 Gm.) of finished salt are reckoned as a teaspoonful. Then if 10 grains of a salt are desired at a dose, the mixture which is to be granulated consists of 80 grains of effervescing mixture (with sugar) and 10 grains of medicament.

Since each 90 grains represents one teaspoonful, or ordinary dose, 20 teaspoonfuls would weigh 1,800 grains, or a little less than 4 troy-ounces, which is a convenient quantity to operate upon.

In this quantity 600 grains of sodium bicarbonate may be used with 500 grains of citric acid or 540 grains of tartaric acid. To these amounts are added 5 times 20 grains, or 10 times 20 grains or 20 times 20 grains, as the case may be, of the active medicinal ingredient and enough sugar to make the whole weigh 1,800 grains.

Thus a granulated effervescing potassium bromide, containing 5 grains to the teaspoonful, would require 600 grains of sodium bicarbonate, 540 grains of tartaric acid, 5×20 grains $=$ 100 grains of potassium bromide, and $1{,}800 - (600 + 540 + 100) = 560$ grains of sugar.

In a few cases it might be advisable to vary the proportions of soda-acid mixture to sugar, but the above will give quite satisfactory results in a large number of cases. A good idea of the varieties may be obtained from a comparative study of the formulas for effervescing salts in the Pharmacopœia and National Formulary. The official granular effervescing citrate of magnesium is a very troublesome salt to make, and does not yield a clear solution, consequently it is seldom found in the market.

Numbers 292, 293, 294 and 296 in the exercises are types of the commercial substitutes for this salt.

Granulation may be effected in two ways, by means of heat or by moistening.

When sugar and tartaric or citric acids are heated they become soft and sticky, as though moistened. In these mixtures a heat of about 220° F. — a little above that of the water-bath — is required to produce large and even granules. Direct flame should not be used, lest the mixture be burned, and become discolored. A glycerin or paraffin bath will give better results.

The powdered mixture is placed in a tinned-iron or porcelain dish, and heated until it becomes sticky, then it must be kneaded vigorously with a wooden spatula (do not use steel) or a tinned-iron spoon until the entire mass is well granulated, when the mixture is removed from the heat and the stirring continued until cool. In the warm and moist mass a reaction begins between the acid and the bicarbonate present, and a little water is liberated, which aids the granulation. But care must be taken to thoroughly dry the granules before putting into bottles, or the mixture will gradually become damp and lose its effervescent properties. Mixtures containing bromides are liable to discolor under this treatment.

The wet method is more convenient in most pharmacies, and gives just as good results when carefully performed.

It consists in moistening the mixed powders with a liquid which possesses only a slight solvent power upon it, and when the mass has become sticky drying it quickly by aid of a gentle heat.

Alcohol is most suitable for small quantities of salts.

The mixed powders are placed in a suitable dish, and alcohol gradually stirred in, until the mass coheres into small granular lumps. If large granules are not required no sifting is necessary, but when large granules are to be obtained the mass is made a little more moist, until relatively large lumps are formed, then these are broken up and the granules made even by sifting.

Do not use enough alcohol to make a paste, nor attempt to conform the granules to the size of sieve which is used. The granules are formed entirely by the cohesiveness of the moist mass, under the influence of kneading. In cold and dry weather the granulated salt is readily dried by spreading upon a tray or clean paper, which is then placed upon a register or radiator, or in any current of warm air.

In warm and muggy weather it is difficult to dry these salts thoroughly, and recourse must be had to a drying-oven or closet.

As soon as the salts are dry they may be sifted and the finer portions regranulated or saved for a future lot.

The granulated salt should then be bottled and the bottles tightly stoppered, as the salt soon loses its effervescing qualities on exposure to the air. They keep best when dried at a very low temperature, and if a drying-oven be used the heat should not exceed 100 to 110° F.

DIVIDING POWDERS. — Guess-work is never proper in the dividing of powders.

When the powders are comparatively large and accurate dosage is not necessary, the powders may be divided by means of a cup-shaped measure.

These are often used in dividing seidlitz powders, but for such constant use they need to be standardized frequently. The edges of the cup wear away quickly, and the capacity of the cup gradually diminishes.

By far the best way for all kinds of powders, particularly if a large number of powders are to be made, is to weigh each separately. This can be done very quickly, as the hand and eye soon become accustomed to the necessary quantity, and after a few powders have been weighed approximately the right amount can be placed upon the balance each time, and the adjustment quickly made. Care must be taken, however, not to give overweight, particularly when a definite quantity of mixture is to be divided into a definite number of powders. It is very easy, for instance, in dividing 24 grains of mixture into 12 powders, to place $2\frac{1}{11}$ grains of powder upon the pan each time, and obtain 11 powders thereby, instead of 12, or by a slight deficiency in each weight to find a part of the mixture remaining after all the powders have been folded.

The Next Best. — It is much more difficult to weigh small powders satisfactorily than large ones, and for this reason most pharmacists prefer to divide these upon the pill-tile in a manner similar to the dividing of pills. The powder is placed upon the tile and built up into a rectangular pile, one edge of which is parallel and close to the division-scale of the tile. This is readily done by means of a couple of straight-edged spatules, care being taken to get the surface of the pile as well as the edges straight and even. The pile is now divided into the desired number of parts by cutting with the spatula, the division-scale serving as a guide.

Occasionally a powder or a mixture is obtained which flows so easily that it cannot be built into a parallelogram, and this must be divided by weight, or by means of a suitable mechanical divider, of which there are several in the market.

PAPERS.

The folding of powders in papers (*chartulæ*) is an art which is acquired only by practice.

When only two or three powders are dispensed at a time, they may be enclosed in a small envelope, but a number of powders are sent out preferably in a box. The papers should be selected to fit the powders, and folded to fit the box.

Hygroscopic, deliquescent, effervescent, or otherwise changeable substances, should be folded first in white calendered papers, then these are folded inside of paraffined or parchment papers to exclude moisture.

Powders intended for making lotions, or otherwise for external use, should be folded in colored papers as a distinguishing feature.

WAFERS.

Wafers are folded by moistening one side of the wafer-paper before placing the powder upon it, then, while moist, folding in the same manner as a powder, but as small as possible. If too wet they do not fold nicely, and if not moistened enough they break, but a very little practice will enable one to get the proper degree of wetness, and they can then be folded as nicely and easily as papers. When dispensed the patient should be given explicit directions for taking them.

They are easily swallowed after soaking for a few seconds in a spoonful of water, and are tasteless. Do not soak long enough to cause them to break in the mouth.

CACHETS.

In filling these care should be taken to get the whole of the powder in the center of the cachet. If any is spilled upon the edge the taste may be noticeable when the cachet is swallowed. In cachet-filling machines funnels are included for this purpose, as also some arrangement for moistening the edge of the cachet and pressing the two halves together. A little talcum on the plunger will prevent the powder or the cachet from sticking to it.

But little moistening is needed, just enough to cause the two parts to adhere. Too much moisture causes the edges to shrivel and the appearance is spoiled.

Like wafers, they are easily swallowed after dipping into water, and full directions for their administration should be given.

CAPSULES.

Capsules are shells of gelatin into which medicinal bodies are put, and are designed to be swallowed in the same way as pills. The purpose of capsules is to cover the taste of the medicines, and any form of medication, solid, liquid or pasty, can be employed in capsule form.

There are two forms of capsules — hard capsules, consisting of a deep cup-shaped form with a similar cover which closes the open end, and soft capsules, ovoid in form, of flexible gelatin, designed particularly for inclosing oils and non-aqueous liquid bodies.

Empty capsules in various sizes are purchased by the pharmacist, and it is the manner of filling them which concerns him particularly. Concerning the best method, there is a diversity of opinions, when the substance is in powder form.

Powders can be put into capsules in the powder form, or a pill-mass can be made and placed in the capsules. The latter is usually the easier method, and often makes the dispensing of a smaller capsule possible. But the massing of powders is not always permissible, and then the capsules must be filled with the dry powder. When suitable funnels and holders are at hand the filling is an easy process, but without suitable apparatus it is a troublesome and particular operation to fill capsules without leaving some on the outside to taste when the operation is finished. Since their chief purpose is to prevent taste, a slight trace on the outside may defeat this.

There are several filling apparatuses in the market, all consisting of a holder or main shell of the (hard) capsules, and a funnel arrangement for pouring the powders into the capsule. A plunger of wood or metal serves to pack bulky powders into the capsule. When one of these apparatuses is used, the powders are mixed and divided in the usual manner, then instead of folding into papers, each powder is enclosed in a capsule. This method offers no special difficulties.

In the absence of a capsule-filling apparatus it is scarcely possible to avoid getting some of the powder on the outside of the capsule. The usual method with mixed powders is to divide them as for papers, then taking the body of the capsules between the thumb and fingers of one hand and the cover in the right, fill both by shoving through the powder repeatedly. The caps are then put on tightly, and the capsules are rinsed thoroughly with strong alcohol (if the powders are soluble in alcohol) or with diluted alcohol (if soluble in water) to remove that which adheres to the outside, then wiped dry. The rinsing should be thorough to prevent any taste of the powder when the capsules are filled, but water must not be used for rinsing.

When a single substance, in powder form, such as quinine sulphate, is to be put into capsules, it is the practice of some to omit the dividing and fill the capsules to the weight desired from a pile. The powder is poured upon a piece of clean paper, and the body of the capsule is plunged downward into it repeatedly until full. The cover may likewise be partially filled and the two when fitted together presses the powder tightly inside. The capsules are then washed with alcohol, as above and dried.

This method necessitates weighing each capsule as filled, with such repetitions in weighing each as may be necessary to secure accurate dosage. When a considerable number of capsules are to be filled, they can be done quite rapidly by this method.

Some powders lack adhesiveness and cannot be filled into capsules in this way, because they flow out when the capsules are lifted from the pile instead of adhering. These may be dampened with a little alcohol or water, as in making triturate tablets, and the damp powder will usually adhere. A mass should not be made.

Or the powder may be pushed into the capsule with a spatula.

When a mass is made before inserting into capsules, the powders are massed as in making pills, and the mass rolled into a pipe and cut. The cut pieces should be as long as the closed capsule, and as large as will go into it. The hands are then washed, the piped pieces picked up with a pin and inserted into the capsule and the top put on. None of the substance is allowed to touch the outside of the capsule.

Mr. Alpers recommends that the mass be divided by weight instead of on a slab or pill machine.

Masses are allowable when the ingredients consist in part of liquid bodies which cannot be absorbed to form a powder without unduly increasing the bulk.

Also for aqueous fluids, which cannot be put into capsules in the fluid condition. Methylene-blue, an intense dyeing substance, is frequently ordered in capsules, and is such an intense coloring agent that it is a problem to avoid leaving the outside of the capsule colored. Some advocate making a mass of it, then rolling the pipes in charcoal and inserting. The charcoal prevents soiling the capsule when inserted. Other powders may, if conditions require, be massed, but as a rule more satisfaction will be given the doctor and patient if powders are filled into capsules dry.

Liquids are usually dispensed in soft capsules, *i. e.*, capsules made of gelatin with enough glycerin to keep it flexible and slightly elastic. These are oviform and in one piece, with an elongated neck at one end. When filled the necks are cut off, and the capsules are stood on end in sockets of wood or plaster of paris. The liquid is then dropped into them from a pipette, care being taken not to get any on the outside, then the capsules are sealed, either by melting the detached necks and applying the melted fluid to the open end of the capsule, or by pressing a hot spatula on the open end, which melts the gelatin and causes it to flow together. After sealing the capsules should be set aside in a cool place for a few hours to allow the gelatin-seal to set firmly.

Powders are occasionally, though rarely, put into these soft capsules. The powder should be poured in through a funnel to avoid getting any on the outside of the capsule.

A powder-box cover set on an incline, or perforated to hold the capsules in position makes a good holder for the capsules while they are being filled.

Soft capsules should not be completely filled, but a small air-space left to preserve the elasticity. Aqueous fluids must not be put into capsules lest the gelatin be softened and the contents spilled. Oils of all kinds are suitable for filling, also strong alcoholic fluids. Creosote, if put into *soft gelatin* capsules, must be first mixed with twice its volume of a bland oil or it will exude through the capsule. This is due to the solubility of creosote in glycerin, which perforates the capsule.

Liquids may also be dispensed in hard capsules. In this case the liquid is dropped into the body of the capsule from a pipette, then the cap is moistened on the inner edge with water and pressed into place. The water softens the gelatin and seals the capsule. Creosote may be put into hard capsules without diluting, the capsules thus being smaller.

W. G. Taplis has suggested the following method of putting volatile oils, terebene, etc., into hard capsules. The terebene or oil is first mixed with an equal weight of starch, and a very few drops of water is added to form a stiff mass, which is then piped and inserted as a mass. There is no danger of leaking in this method, wherein is an advantage.

A recent form is known as pearls, and consists of spherical capsules completely filled with liquid or powder. These are beyond the domain of retail pharmacy, the capsules being made and filled at the same time. Special and expensive machinery is required, and the work cannot be done on a small scale.

POWDERS

259.

℞.	Potassii chlor.,	
	Ammonii chloridi	āā ʒ ij
	Senegæ contusæ	ʒ iv
	Glycyrrhizæ contusæ	℥ ij

M. Ft. species bruised

Sig. — Make a quart of tea and drink half a wine-glassful every hour.

260.

℞.	Sennæ	16
	Sambuci florum	10
	Fœniculi	5
	Anisi	5
	Potassii bitartratis	4

Contusa et misce.

Sig. — Laxative species, N. F.

(St. Germain Tea.)

261.

℞.	Althææ	8
	Verbasci foliæ	2
	Glycyrrhizæ	3
	Tussilaginis	4
	Anisi	2
	Iridis	1

Contundantur et miscentur.

Sig. — "Breast Tea, N. F."

262.

Prepared chalk	30 Gm.
Acacia, in fine powder	20 Gm.
Sugar, in fine powder	50 Gm.

"Mix them intimately."

Sig.—Compound chalk powder, U. S. P.

Make one-tenth the quantity.

263.

Ceylon cinnamon, in No. 60 powder	35 Gm.
Ginger, in No. 60 powder	35 Gm.
Cardamom, deprived of the capsules and crushed	15 Gm.
Nutmeg, in No. 20 powder	15 Gm.

Sig. — Aromatic powder, U. S. P.

"Triturate the cardamom and nutmeg with a portion of the Ceylon cinnamon, until they are reduced to a fine powder; then add the remainder of the cinnamon and the ginger, and rub them together until they are thoroughly mixed."

Make 10 grams.

264.

℞. Sulphuris præcip.	7.5
Guaiaci	5.0
Magnesiæ	10.0

M. Sig. — Teaspoonful twice a day.

Triturate the magnesia and guaiac together, then mix these with the sulphur by trituration.

The mixture should readily diffuse through water.

265.

℞. Naphthalini	10.
Acid borici	10.
Camphoræ	0.40

M. Ft. pulv. subtilis. Sig. — Use as a snuff.

266.

℞. Acidi salicylici	0.3
Acidi borici	1.0
Pulveris talci	8.7

M. Ft. pulv. subtilis. Sig. — "Salicylated talcum powder, N. F."

267.

℞. Zinci oxidi	ʒ iv
Acidi carbolici	gr. viij
Acidi tannici	ʒ ss
Amyli	ʒ iij

M. Sig. — Dusting powder.

268.

℞. Amyli	16.
Zinci oxidi	8.
Camphoræ	1.0

M. Ft. pulv. subtil. Sig. — "Dusting powder."

269.

℞. Saccharini,	
Mentholi,	
Thymoli	āā 1
Olei cinnamoni Ceylon	2
Saponis pulv.	50
Cretæ præcip	ad. 1000

M. Sig. — Tooth powder.

270.

℞. Pulv. amygdal. amaræ sine cortice et olei	℥ vj
Farinæ tritici,	
Pulv. iridis	āā ℥ iv
Saponis pulveris,	
Sodii boratis	āā ℥ j
Olei amygdal. amaræ	gtt. x
Olei bergamottæ	ʒ ij
Tinct. moschi	ʒ j

M. Sig. — Almond meal.

271.

℞. Ipecac, in No. 60 powder . 10 Gm.
Powdered opium . . . . . 10 Gm.
Sugar of milk in No. 30 powder . . . . 80 Gm.
M. Sig. — Dover's powder, U. S. P.

"Rub them together *into a very fine powder.*"
Make one-tenth of the quantity.

272.

℞. Pulveris Doveri . . . . ʒ j
In pulveres vi. divide et mitte in capsulæ amylaceæ.
Sig. — 10-grain Dover's powder.

273.

Morphine sulphate . . . . 1 Gm.
Camphor . . . . 19 Gm.
Glycyrrhiza, in No. 60 powder . . . . 20 Gm.
Precipitated calcium carbonate . . . . 20 Gm.
Alcohol, a sufficient quantity.
M. Sig. — Tully's powder, U. S. P.

"Rub the camphor with a little alcohol, and afterwards with the glycyrrhiza and precipitated calcium carbonate, until a uniform powder is produced. Then rub the morphine sulphate with this powder, gradually added, until the whole is thoroughly mixed. Finally pass the powder through a No. 40 sieve, and transfer it to well-stoppered bottles."
Make one-sixth the quantity.

274.

℞. Pulv. morphinæ comp. . . . . . ʒ j
In pulveres vi. divide et mitte in chartulæ amylaceæ.
Sig. — 10-gr. Tully's powders.

275.

℞. Aquilæ albæ . . . . gr. iss
Sacchari lactis . . . . ʒ j
M. Ft. chartulæ xij no.
Sig. — Calomel triturates.
(Aquilla alba — old name for calomel.)

Triturate *very* thoroughly together.

276.

℞. Sodii salicylatis 1.30
Sodii bicarbonatis 2.00
M. In pulveres decem divide.
Sig. — Capiat pulverem unam ex aqua gelida cyathis post cibo.

277.

℞. Calomelanos . . . . gr. x
Magisterii bismuthi . . . . . gr. xx
Saleratus . . . . gr. xl
M. Sig. — Ut dictum.

Triturate the calomel thoroughly with the powdered potassium bicarbonate, then add the bismuth subnitrate and mix gently.

278.

℞. Bismuthi salicylat.,
Salol . . . . āā 10.00
M. Ft. chart. xxiv no.

These make a slippery powder, which cannot be divided accurately in the usual manner. Each powder should be weighed.

279.

℞.	Pulveris thebaicæ	0.325
	Magisterii bismuthi	3.250

Misce in chartulas decem dividenda.

Sig. — Opium and bismuth.

280.

℞.	Pepsinæ	2.0
	Bismuthi subnitrat.	5.0
	Magnesii carbonat	3.0
	Pulv. aromatici	1.0

M. et in chart. xij divide.

Sig. — Capiat unam post cibo.

Mix on paper. Do not triturate.

281.

℞.	Pulveris rhei	gr. xxiv
	Magnesiæ	gr. xlviij
	Olei anisi	m. vj
	Alcoholis	m. x

M. et in chart. vi divide.

Sig. — "Rhubarb and Magnesia."

Mix the powders on paper, or by sifting, and add the oil previously dissolved in the alcohol. Mix this on paper.

282.

℞.	Hydrarg. submur.	gr. ij
	Pulv. rad. rhei.	gr. v
	Elæosacch. menth. pip.	ʒ ss

M. Ft. pulv. dent. tal. dos. no. xij. Dent. in chart. cerat. Sig. — Hora decubitus sumatur unum.

283

℞.	Sodii boratis,	
	Acid borici,	
	Aluminis	āā 15.0
	Acid carbolic,	
	Ol. cassiæ	āā 1.0

M. Sig. — A teaspoonful in a pint of warm water.

284.

℞.	Tinct. opii	1.0
	Plumbi acetatis	1.0
	Sacchari	2.0

M. Ft. pulv. no. vi. Sig. — P. r. n.

Triturate the tincture with the sugar, dry in a warm (not very hot) place, and add the sugar of lead, mixing thoroughly.

285

℞.	Phenacetin	gr. v
	Caffeinæ citrat.	gr. ss

M. Ft. pulv. et mitte tales vi. no.

Sig. — Sumat nocte.

286.

℞. Phenacetin,
Salol . . . . āā gr. v
Caffeinæ citrat. . . . . . . gr. ss
Hydrarg. chlor. mit. . . . . gr. $\frac{1}{10}$
M. Ft. pulv. j no. Disp. pulv. tales no. xij.
Sig. — Ut. dict.

287.

℞. Potassii chlorat . . . . ʒ ij
Acidi tannici. . . . . ʒ j
Sacchari . . . . ʒ ij
M. Ft. chart. xij no. Sig. — One in a tumblerful of cold water, for a gargle.

Powder the ingredients separately, and mix very lightly on paper.

288.

℞. Ammon. carbonat. . . . . . . ʒ ss
Pulv. Tullii . . . . ʒ j
M. et in pulv. vi no. divid. Sig. — One at night.

Mix quickly and dispense in double papers, the outer papers being waxed.

289.

℞. Ammon. bromidi . . . . . . ʒ ss
Sodii bicarbonat. . . . . ʒ ss
M. et in chart. xij divide. Detur in scatula.
Mix lightly and fold in paraffin papers.

If the salts are not perfectly dry, ammonia gas will be liberated.

290.

℞. Quininæ sulphatis . . . . . . gr. ij
Ammonii carbonatis . . . . . gr. iv
Misce et detur tales numero quatuor in chartæ ceratæ.
Sig. — Sumatur una nocte maneque.

291.

℞. Elaterini . . . . gr. ij
Capsici . . . . gr. ij
Ol. tiglii . . . . m. vj
M. et in partes æquales xij divide. Dentur in capsulæ.

Make a soft mass by means of a little powdered soap and water.

292.

℞. Magnesii sulphatis exsic. . . . 3
Sodii sulphatis exsic 3
Potassii carbonatis 10.5
Sodii bicarbonatis 9.5
Acidi tartarici 14.0
Sacchari pulv. 11.0
M. Ft. pulv. effervesc. Da in ampulla.

(About 18 Gm. of Rochelle salt are formed when this is dissolved.)

293.

℞.	Sodii bicarbonat.	14.5
	Potassii bicarbonat.	8.0
	Acidi citrici	9.0
	Acidi tartarici	12.0
	Sacchari pulv.	6.5

M. Ft. pulv. effervesc. s. a. Da in ampulla.

When this mixture is dissolved in water 22.5 parts of Rochelle salt are formed by the reaction between the bicarbonate and tartaric acid. Sodium citrate is also formed.

294.

℞.	Magnesii sulph. exsic.,	
	Sodii sulphatis	āā 6.
	Potassii carbonatis	10.5
	Sodii bicarbonatis	9.5
	Acidi tartarici	14.0
	Sacchari pulv.	7.0

Mt. Ft. pulv. efferv. s. a.

295.

Sodii Sulphas Effervescens [Ph. Br.].

℞.	Sodium sulphate	100 Gm.
	Sodium bicarbonate	100 Gm.
	Tartaric acid	54 Gm.
	Citric acid	36 Gm.

Dry the sodium sulphate until it has lost 56 per cent. of its weight, powder the product and mix it with the other ingredients.

Granulate in the same manner as magnesii sulphas effervescens.

296.

Magnesii Sulphas Effervescens [Ph. Br.].

℞.	Magnesium sulphate	50 Gm.
	Sodium bicarbonate	36 Gm.
	Tartaric acid	19 Gm.
	Citric acid	12.5 Gm.
	Powdered sugar	10.5 Gm.

Dry the magnesium sulphate at about 54° C. (130° F.) until it has lost 23 per cent. of its weight, powder the product and mix it with the sugar, then with the other ingredients. Place the mixture in a suitable dish heated to between 200° and 220° F., and when the particles of powder begin to aggregate, stir assiduously until they assume a granular form; then separate the granules into uniform sizes by sifting and preserve the product in well-stoppered bottles.

CHAPTER XI.

SUPPOSITORIES, BOUGIES, PESSARIES, POLITZER PLUGS.

Suppository (Lat. *Suppositorium-i*).—A solid medicated substance, usually of a conical form, designed for introduction into the passages of the body, there to be absorbed.

Bougie (Lat. *Bougia-æ* or *Bacillum-i*).—This term *bougie* (boo-zhē) is properly employed to designate solid and insoluble or non-absorbable bodies intended to be introduced into passages for the purpose of dilation. These are composed of silver, steel, wax, rubber, gum, etc., and are sometimes smeared with medicinal substances when a medicinal as well as a mechanical action is desired. The term is often used to designate medicated suppositories of gelatin, wax, cacoa butter and wax, etc., for nasal or urethral use.

Pessaries (Lat. *Pessum-i* or *Pessarium-i*).—In like manner the term *pessarie* properly denotes an instrument introduced into the vagina for the support of the uterus, but is often applied to vaginal suppositories.

Politzer Plugs.—Plugs of greased cotton for insertion into the ear. Used for protection after operations on the ear.

This form of medication may be intended for local diseases or for general absorption. Medicines introduced into the rectum in a proper condition, will produce their characteristic effects upon the system in the same way as when swallowed. Foods are also given in this manner in special cases, as after surgical operations, or when the stomach is in an irritable or weak condition and is unfitted for the reception of food or medicines. Suppositories are generally employed for local treatment, as in hemorrhoids, or when for any reason, medicines cannot be taken into the stomach. As a rule, medicines act more slowly in this form and slightly larger doses are required than when administered by the mouth.

Strychnine is, however, a notable exception.

ESSENTIALS.

Suppositories should be of firm consistence when cold, should melt at or slightly below the temperature of the body (98° F.), should be non-irritating, and must not become rancid.

The size and shape is governed by the use to which the suppository is to be put. Those designed for the rectum or vagina are usually bullet or cone-shaped, the vaginal suppositories being made about twice as large as the rectal.

Suppositories designed for the urethra or nasal passages are made into slender rolls ¾ inch to 2 inches in length, pointed at one end and weighing from 10 to 15 grains. Urethral suppositories made of gelatin are sometimes directed as long as six inches.

Suppositories for the aural cavities are a compromise between the two forms, or are cartridge-shaped and weigh 5 to 10 grains.

Suppositories were first introduced into the U. S. Pharmacopœia in 1870.

The present (1900) Pharmacopœia requires that rectal suppositories shall be cone-shaped, and if of cacao butter shall weigh about 2 grammes; urethral suppositories pencil-shaped, and shall contain about 2.5 grammes of glycero-gelatin vehicle, or about 1 gramme of cacao butter; and vaginal suppositories globular and weigh about 3 grammes, if of cacao butter, or 10 grammes if of glycero-gelatin.

BASES.

Cacao butter * (*Oleum Theobromatis*) is probably the best general base for suppositories, and should be used for prescriptions unless another base is designated.

This is hard and wax-like at ordinary temperatures, but melts at 86° to 94° F., has a specific gravity of 0.950 to 0.998, and can be readily incorporated with small portions of aqueous substances, or with oils, etc., and does not become rancid.

When mixed with volatile oils, chloral, creosote, carbolic acid, etc., the melting-point is lowered to a considerable extent. This may be corrected by adding spermaceti. Castor oil also has a peculiar hardening effect, and is preferable to wax, particularly for chloral suppositories. If needed, equal parts of spermaceti and cacao butter may be used. A mixture of 7 parts of cacao butter with one of spermaceti has been recommended for suppositories and bougies which are desired to melt very slowly, and thus exert a prolonged action.

Spermaceti is sometimes added to those which are designed to absorb very slowly, as in hemorrhoids, etc., in order to bring the melting point of the suppository to as near the temperature of the body as possible. A mixture of 7 parts of cacao butter and 1 part of spermaceti melts near to 98° F.

Wax or paraffin raises the melting point higher.

Lard should not be used in suppositories, because of its tendency to become rancid.

Lanolin is a useful adjunct to suppositories containing large amounts of extracts or aqueous fluids. This absorbs the liquid better than cacao butter, mixes well with the latter, and affects the fusing point but little. Lanolin is also more readily absorbed.

Hollow suppositories of cacao butter were introduced into pharmacy some years ago.

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* Cacao butter or cocoa butter (the first term is preferable) is a concrete oil obtained from the seeds of *theobroma cacao*, or chocolate plant. It is separated from chocolate by heavy pressure between heated plates, and commercially is a by-product of the manufacture of cocoa for drinking or flavoring purposes. It should not be confounded with cocoanut butter, a semi-solid oil obtained from cocoanuts (*cocos nucifera*) which is not firm enough to use for making suppositories.

These come in the various forms and sizes and resemble the ordinary moulded suppository, but consist only of a thick shell of cacao butter, with an opening at the top for the introduction of the medicinal matter. A cap or plug of cacao butter, which is slightly warmed just before inserting to soften its surface, serves to seal the suppository after the medicaments have been placed inside. These are intended to be used in place of the usual forms, but have not proved acceptable for several reasons. The labor of mixing, dividing, and inserting the medicinal matter, particularly when extracts are used, is often as great as that involved in making a corresponding suppository entire, either by hot or cold process; no medicinal effect can be produced until the suppository has entirely melted, and then the condition of the medicament may not be the best for absorption; and the appearance of the suppository offers no clue to the nature, condition, or strength of its contents.

Soap is sometimes used as a base for suppositories, particularly when a laxative action is desired. Soap cones, made from ordinary castile soap, are used to produce evacuation of the bowels, which it causes by a slight irritant action.

The British Pharmacopœia uses a mixture of curd-soap (a soap made with soda and a purified animal fat) and glycerite of starch, stiffened, if necessary, with a little powdered starch, for its carbolic acid suppositories, morphine suppositories with soap, and tannic acid suppositories with soap.

These are made by the cold process, shaping the suppositories by hand.

The glycerin suppositories of the U. S. Pharmacopœia have a similar soap base, but without the starch.

It should be remembered that, in making suppositories with a soap base, **soap is incompatible with metallic salts,** forming an insoluble metallic soap, and hence is unsuitable for such. Soap also affords a good medium for incorporating aqueous fluids with cacao butter.

Gelatin is preferred for bougies and soluble pessaries, and at times for vaginal or glycerin suppositories.

Gelatin is soluble in hot water and in hot glycerin, the solutions becoming firm and elastic when cold if more than 5 per cent. of glycerin is present. Salts and acids tend to liquefy gelatin, thus softening the suppository, while tannin, alum, creosote, formalin, etc., form an insoluble compound and thus make a hard and less soluble suppository. Gelatin suppositories containing glycerin, and no water, change less readily than a hydrated gelatin base. Professor Hallberg recommends the following **Anhydrous Glycero-Gelatin** for general use. One hundred grammes of gelatin are covered with cold sterile water, allowed to stand one hour, then the water is drained off. One hundred grammes of glycerin is then added, and the whole is heated on a water-bath in a tared dish until the gelatin is liquefied and the whole product weighs 200 grammes. The liquid is strained and allowed to solidify. When medicated suppositories are made with this, the substance, if very soluble in water, is dissolved in a little water, enough glycerin is added to weigh one half the total quantity required. An equal weight of the glycero-gelatin is then melted, the solution is added, and the mixture poured at once into molds. The molds may be lightly greased with petrolatum.

Insoluble powders—as iodoform, carbonates, oxides, etc.—should be thoroughly rubbed with glycerin, to make half the required quantity, then mixed with an equal weight of melted glycero-gelatin and poured immediately into molds. A firmer consistence may be secured with water-soluble substances, by substituting mucilage of acacia for a portion of the water or glycerin.

This vehicle makes suppositories containing about 25 per cent. of gelatin, and can be employed for any of the medicinal substances used in suppositories. Tannin, alum, etc., mix better with this than with a base containing water, hence no water should be employed for dissolving these. They are soluble in glycerin, and that alone must be employed. If the gelatin hardens when first mixed, continued heating will re-liquefy it. They are not, however, suitable bodies for combining with gelatin.

Softer suppositories can be made by decreasing the gelatin. The same glycero-gelatin mass may be used, but enough glycerin is added to reduce the proportion of gelatin in the finished suppository to 5 to 10 per cent. Delaye recommends a 7 per cent. gelatin for bodies which are soluble in gelatin; an 8 per cent. for vegetable extracts and liquid bodies like ichthyol, creolin, etc., and a 10 per cent. for hygroscopic bodies, and very soluble bodies, as chloral, iodides, etc. These require longer to set than the larger proportion of gelatin, and should be allowed to remain in the molds 12 hours.

In certain cases glycerin is too irritating for use, and a hydrated gelatin vehicle must be employed.

L. A. LeMieux prefers the following mixtures:

Formula No. 1.—Gelatin 40 parts, glycerin 25 parts, water enough to make 100 parts.

Formula No. 2.—Gelatin 40 parts, glycerin 25 parts, acacia 25 parts, water 200 parts. Evaporate to 100 parts.

Formula No. 1 is adapted for general use, and No. 2 is suitable for warm or moist atmospheres, or for very hygroscopic bodies.

The molds should be warmed before pouring, particularly urethral molds.

For extra long urethral suppositories, and for unusual sizes or shapes of other suppositories, molds made of oiled paper serve excellently. They are formed over a pencil or any convenient object, and when the gelatin has set the paper cover is removed and the suppositories trimmed.

Gelatin suppositories are useful in cases where fats are objectionable, but are not as agreeable to the patient as suppositories made with cacao butter. The gelatin has a rubber-like feel, and clings to the surfaces unless wet with water immediately before inserting; moreover, it is less quickly absorbed. They should be kept in a *dry* and *cool* place, since they are hygroscopic, and will melt if moistened.

Other Bases. — The three bases mentioned — cacao butter, glycerin-gelatin and soap — have been found satisfactory in all cases thus far, and there seems to be no demand for others. Many mixtures of common fats and waxes, or of new bodies, have been proposed at various times, but the advantages offered are in nearly or quite all cases offset by corresponding disadvantages, and they have attracted only a momentary attention. Probably the above three bases will continue to be used almost exclusively for many years to come, and the following which have been proposed are mentioned merely as interesting substitutes.

Equal parts of oleic and stearic acids give a mixture for which the following advantages were claimed by Mr. Martindale: It melts at the temperature of the body, shrinks upon cooling, and the suppositories are thus easily removed from the molds; the suppositories are very firm, and the proportions may be varied to suit varying conditions of temperature, ingredients, etc. It also is an excellent solvent for alkaloids, and is readily absorbed.

This is probably the best substitute for cacao butter that has yet been proposed.

Cocoanut stearin, stiffened with a small proportion of wax is stated to make a less expensive base than cacao butter. It has a tendency to become rancid, which is objectionable.

A mixture of anhydrous lanolin and stearin is claimed to make an excellent base, which is permanent and more easily absorbed than cacao butter.

For making urethral suppositories (bougies) N. Pritzku, Ph.G., has recommended a mixture made as follows: A troy ounce of cacao butter is melted and mixed with four drachms of powdered acacia, then four fluidrachms of water and two of glycerin are incorporated, and when well emulsified the mixture is chilled. When required for use, the medicinal agent is first incorporated with a little cold cacao butter, then triturated with the above mixture in suitable quantity, and the suppositories are rolled out by the cold process. Dry powders may be mixed with an equal weight of glycerin instead of with cacao butter, before adding the mixture.

A bougie-mass sometimes used for vaginal bougies is made by mixing 6 c.c. of glycerin with 6 c.c. of water, and pouring this upon

10 gm. of powdered elm bark, which is then quickly worked into a mass and divided into 6 globular bougies. The mass must be worked rapidly, for it hardens in about ten minutes. After 24 hours the suppositories become hard and elastic, but after being inserted into the vagina they soften and swell, making both a mucilaginous fluid and a distension of the walls. Medicinal agents may be incorporated.

MOLDS.

Molds are of various kinds, the most common being of brass, nickled iron or white-metal.

Those which separate longitudinally are easier to use, rendering the ejection of the suppository much easier.

Two sizes are needed; one for rectal suppositories and one for vaginal. A pessary or urethral mold is also desirable.

All molds should be standardized, or the amount of base metal which they will hold ascertained, as soon as received.

They are usually designated as 15-grains, 20-grains, 30-, 45-, 60-, 120-grains, etc., but the amounts which they will actually hold will commonly vary a little from these figures. The beauty and value of the suppository demands that the molds be well filled, and that none of the mass containing a part of the medicinal agents be wasted, hence the capacity of the mold should be accurately known.

It is more convenient to know the volume-capacity of the molds, since this will be the same for all bases.

This is quickly ascertained by over-filling the molds with cacao butter, allowing this to solidify, and after removing all excess of butter remelting the suppositories so obtained. The liquid fat is now measured in a graduate, or a test-tube which is thereafter kept for that use. Rectal molds commonly hold four to six drachms of melted cacao butter per dozen suppositories, and vaginal molds two to four times these quantities.

When a new base or a mixture of bases is used, the quantity necessary for filling the molds is readily obtained by measure.

A ready means of ascertaining the capacity of a mold is to fill it with water from a pipette, and multiply the number of minims of water required by 0.9 to get the capacity in grains of cacao butter.

Metallic molds should be kept clean and dry. If allowed to become rusty the surface is roughened and the appearance of the suppository is marred, as well as the difficulty in ejecting it from the mold increased.

Extemporaneous molds may be made by rolling waxed paper or tin-foil upon a wooden form and then sticking into wet sand. Upon withdrawing the form the paper mold is left in the sand ready for use.

Plaster-of-Paris molds are made by preparing a thick cream of plaster-of-Paris with water, which is then poured into a suitable box or frame, and suppositories of wax inserted until the plaster hardens.

The wax suppositories are then removed, the edges of the mold smoothed, and the mold rendered less absorbent by boiling for a short time in linseed oil.

Suppository machines or compressors are in common use at present. In these the cold mixture of base and medicaments is placed in a strong cylinder or hopper, and forced by pressure, applied by means of a screw, into the molds. These make smooth, hard suppositories, and are especially useful in making large quantities.

More care is required in mixing the mass than when the mass is melted and poured into chilled molds.

THE MANUFACTURE OF SUPPOSITORIES.

This is accomplished by three processes, viz., the hot process, the cold process, and by means of a suppository machine or compressor.

In making them by the hot process sufficient cacao butter is first weighed out to just fill the molds, and about two-thirds of it placed over a water-bath in a capsule or cassarole. While this is heating the medicinal ingredients are weighed out and prepared for incorporating with the remainder of the cacao butter.

Powders or salts should be rubbed to an impalpable powder, taking special care that no grit or small lumps are allowed to remain, then mixed thoroughly with the cacao butter which has been reserved.

Extracts should be first softened and rendered semi-liquid by means of a little water or diluted alcohol, then incorporated with the reserved cacao butter.

In the meantime the cacao butter which was placed in the capsule has melted, and the capsule containing it should be removed from the heat and its contents allowed to cool to 95° F., or lower, then the medicated butter, now rendered soft by friction, is added to that in the capsule, where a little stirring with a spatula or glass rod will render the whole liquid and homogeneous.

The fluid is now poured into the chilled molds and the molds allowed to remain on the ice until the suppositories have hardened.

The temperature at which the mixture is poured into the molds is the critical point with most suppositories. If too hot, insoluble salts will settle at the apex of the suppositories before the mass stiffens sufficiently to hold them in suspension. Extracts, particularly extracts of belladonna, stramonium and hyoscyamus, are precipitated in granular condition by the least excess of heat and cannot again be reincorporated, while volatile bodies, alkaloids, etc., may be driven out or decomposed by the heat. The mass shrinks on cooling, and if poured while hot, a depression forms at the top of the suppository, which is unsightly.

Moreover, the suppositories are more easily removed from the molds and consequently less liable to break if the mass has begun to thicken before being poured.

A little practice will enable one to judge of the proper temperature of the melted butter without the use of a thermometer.

The capsule will not feel warm to the hand, and the butter will show signs of thickening. If the medicinal agents and the cold cacao butter be triturated vigorously just before it is added to the melted butter, it will become softened by the friction and liquefy the more readily.

Should a little additional heat be necessary it must be applied cautiously.

A momentary application to the water-bath, then a brief stirring with a glass rod, and the process repeated if needed, will suffice and will avoid overheating.

It should be remembered that in the melting of any solid body latent heat must be absorbed, and if done rapidly the portion first melted will become heated far beyond its critical point before the last portions of the solid become liquefied, hence the necessity of first melting a portion of the cacao butter and allowing this to cool before adding the medicinal agents.

The Pharmacopœia allows the **sprinkling of the molds** with lycopodium.

This is usually not necessary if the molds be well chilled before pouring in the mass.

Some prefer to use a little fixed oil or petrolatum rather than lycopodium, while soap-liniment is favorite with others.

The latter should never be used for suppositories containing metallic salts, lest a reaction occur between the soap and the salt. An alcoholic solution of castor oil is a good substitute in these cases.

Still another way of preventing sticking is to line the molds with tin-foil or waxed paper.

The molding of urethral suppositories is often troublesome. If the molds are well-chilled the mass will often congeal before reaching the bottom of the mold, leaving a portion unfilled.

The better way is to pour the mass into the molds before chilling, then chill thoroughly, and after the mass has congealed remove from the ice and allow to stand until the mold has acquired the temperature of the room again.

This is necessary because, in chilling, the metal of the mold contracts more than the cacao butter, and grips the suppository tightly when very cold. Upon allowing the mold to warm in the air, the metal expands and allows the suppository to slip out.

Extemporaneous urethral molds are best formed of in foil or waxed paper. They are especially convenient for making gelatin bougies of different sizes.

A glass tube rounded at the end, and not entirely closed, makes an excellent form. The suppositories should be made 2 to 2½ inches long and ⅛ to ¼ inch in diameter. The waxed paper or foil having been wrapped smoothly around the glass tube, the tube is then gently withdrawn, the air-vent in the end allowing of its easy removal, and the shell makes an excellent mold. It will be found difficult to remove the shell from a pencil, if substituted for the glass tube, owing to suction of the air.

In pouring the melted mass from a dish into the mold, there is a slight loss due to the adhesion of the melted fat to the dish, and unless considerable care is exercised the dispenser may not be able to fill the last mold. The size of the dish has much to do with this, as also care in manipulating. But good dispensers allow for this loss by making an extra quantity of mixture. Thus, if a dozen suppositories are desired, enough mixture is made for thirteen suppositories, and twelve are poured. This insures a full and accurate dose of medicinal agent in each suppository.

In the absence of ice the molds may be chilled by spraying ether upon their surface from an atomizer. The rapid evaporation of the ether quickly chills the metal as effectually as when ice is used. Only a little ether is needed. Carbon disulphide, benzine, chloroform and other easily volatilized liquids can be used in the same way.

Another method is to cool the mold in a "freezing mixture," obtained by quick solution of a salt in water.

The mold is three quarters submerged in water in a suitable vessel, then a definite proportion of some quickly-dissolving salt is stirred in, which lowers the temperature of the water as it passes into solution and thus chills the mold. If the suppositories do not harden readily two such treatments may be necessary, one for the preliminary chilling and one after the molds have been filled. In many cases the salt may be divided, and one portion used for the first chilling, while the other is reserved for use in the second. For instance, if the mold be put into a dish containing not more than 14 fluidounces of water, then 2 ounces of ammonium nitrate added and quickly dissolved by stirring, the mold will be cooled enough for the pouring. Then as soon as the molds are filled, 2 ounces more of ammonium nitrate are added, and suffices for the hardening of the suppositories. The solution may afterwards be evaporated and the salt recovered for subsequent use.

The following table gives a list of salts most suitable for this purpose, and the proportions by which the lowest temperature is obtained.

	Lowers the temperature.
Ammonium nitrate 1 part, water 1 part	27° C.
Ammonium chloride 1 part, potassium nitrate 1 part, water 1 part	35° C.
Potassium sulphocyanide 5 parts, water 4 parts	33° C.
Glauber's salt 8 parts, hydrochloric acid 5 parts	27° C.
Sodium phosphate 9 parts, diluted nitric acid 4 parts	39° C.

The salts should be finely powdered, used in just the above proportions and quickly stirred, in order to obtain the above results. The limit of temperature depends upon the degree started with and the limit of solubility.

The cold process is preferred by many, being more sure of success, and often more quickly finished, even on a large scale. For this method the entire amount of cacao butter should be grated or shaved off, and then mixed with the medicinal ingredients in the same way that a pill-mass is worked.

A little oil of sweet almond or glycerin is worked in, about a drop to each suppository, to render the mass more cohesive. After working the mass in a mortar until it has become homogeneous and plastic (taking care that no particles of cacao butter show in the mass), it is taken out and worked in the hands or on a pill-tile until formed into a cylinder. It is then cut into the required number of pieces, and each piece formed into a conical (or otherwise) suppository, by means of the fingers and a broad spatula.

Practice is required in this method in order to work rapidly, and make smooth and even suppositories, but the skill is easily acquired and the process gives satisfaction.

If the mass begins to break, its plasticity may be restored by working thoroughly in the hands. On the other hand, if handled too much the mass begins to melt.

In warm weather or in a warm room it may be necessary to cool the hands from time to time by immersing them for a moment in ice water and wiping quickly.

The pill-tile should be kept well dusted with lycopodium or starch while working the mass upon it. Starch is to be preferred in most cases.

When a compressing machine is used, the mass is made in the same manner, then placed in the cylinder and forced into the molds. Suppositories made in this way look much like those made by the hot process.

The machine and molds should be thoroughly cleaned after each mass, or succeeding lots may appear streaked.

COATING SUPPOSITORIES.

Suppositories containing hygroscopic substances, as glycerin, or very volatile bodies, are sometimes protected by coating or wrapping them.

Flexible collodion, paraffin, and wax are used as coatings. The suppositories are impaled upon needles and dipped quickly into the collodion or melted wax, then set aside until the coating has hardened.

These are good protective agents, but have been objected to because patients frequently neglect to remove the coating before inserting the suppository, and it does not melt or absorb, as intended. When dispensed with coatings, plain directions for the removal of the films should be affixed to the container and verbal instructions also given to the patient.

Similar protection is afforded by wrapping the suppository in tinfoil or paraffin paper. It is generally preferred, however, to dispense such as need be protected from the air in tightly stoppered bottles or in glass tubes containing only one or two suppositories.

Politzer Plugs are allied to bougies, in that they are made for insertion into the meatus of the ear for protection. They are not medicated, but are intended only for protecting the inner ear after surgical operations, or for special reasons. They are made of greased cotton in the following manner: A small pellet of absorbent cotton is first pierced with a thread so that it will hang from about two inches of the double thread. With the fingers, the cotton is thoroughly greased with simple cerate and made into a pellet about the size of a coriander seed. When well greased, a thin layer of fresh cotton is folded smoothly over it, and the latter is greased with the ointment in turn. Then another layer of cotton is put on and greased in its turn, and the process is continued until a ball is made which will fill snugly the meatus of the ear and exclude the air without distending it or causing discomfort. Varying sizes will be needed to fit the patient.

When inserted, the thread is left hanging out and is utilized for removing the plug from the ear.

The innermost pellet of cotton needs but a little greasing and should not be made into a hard ball, but the outer layers must be thoroughly greased and put on firmly. This makes a plug which is firm on the outside, but a little elastic and so fits the meatus of the ear snugly. The thread can be put into the plug after it has been formed if desired.

Dispensing. — Suppositories should be sent out in tight boxes lined with impervious paper. Special compartment boxes are employed in many cases, so that the suppositories do not come in contact with each other. These are to be preferred; but plain, well-lined boxes may be employed in most cases, the suppositories being wrapped in waxed paper or tin-foil. If the suppositories are soft, a little starch or lycopodium may be sprinkled upon them. It is not necessary to bury them in powder. In all cases a label upon the box directing its storage in a cool place is almost a necessity.

SUPPOSITORIES.

297.

℞. Glycerin . . . . 60 Gm.
Monohydrated sod. carbonate 1.5 Gm.
Stearic acid . . . . 5 Gm.
M. s. a. Make ten rectal suppositories. Sig.—Glycerin suppositories, U. S. P.

Dissolve the sodium carbonate in the glycerin in a capsule on a water-bath; then add the stearic acid, and heat carefully until this is dissolved and the escape of carbonic acid gas has ceased. Then pour the melted mass into suitable molds, remove the suppositories when they are cold, and wrap each in tin-foil. These suppositories should be freshly prepared when required.

Make one-third the quantity and pour into vaginal molds.

298.

℞. Acidi stearic 0.250
Sodii carbonat. exsic 0.250
Glycerini. 9.500
M. Ft. supposit. no. v. Sig.—Transparent glycerin suppositories, 95 per cent.

299.

℞. Gelatin . . . . 2 Gm.
Glycerin . . . . 10 Gm.
Distilled water . . . . . . q. s.
Make six rectal suppositories.
Sig.—Glycerin suppositories, Ph. Br.

Place the gelatin in a weighed evaporating dish with sufficient water to cover it, allow it to stand a minute or two, then pour off the excess of water; set aside until the gelatin is quite soft, then add the glycerin. Heat on a water bath until the gelatin is dissolved and the mixture has been reduced by evaporation to 13 grammes, and pour into molds.

300.

℞. Camphoræ 2.00
Olei thebromat. . . . . q. s.
M. Ft. supposit. vj no. pro recto.
Sig.—"Camphor suppositories."

Dissolve the camphor in the melted butter and pour the solution into the molds.

301.

℞. Iodoformi. . . . . gr. vj
Acidi tannici . . . . gr. xij
M. Ft. supposit. pro recto vj no.
Sig.—"Iodoform and Tannin suppositories."
(Caution: Avoid overheating these.)

302.

℞. Mitte Suppositoriæ Iodoformi pro recto āā gr. ij no. vj.
Make by two methods.

303.

℞. Plumbi acetat 1.20
Pulv. opii 0.40
Olei theobromatis . . . . q. s.
M. Ft. supposit. pro recto vj no.
Sig. — "Lead and opium suppositories."

304.

℞. Chloralis 2.00
Olei theobromatis . . . . q. s.
M. Ft. suppos. pro recto vj no.
Sig. — "Chloral Suppositories."

For cold process, powder the chloral, incorporate with cacao butter and form into suppositories.

For hot process, melt 1.5 Gm. spermaceti. Mix with 5 Gm. of warm cacao butter, dissolve the chloral in the warm (not hot) mixture, add enough cacao butter to make up to the full volume of the molds (ʒ iiss), mix well and pour into the chilled molds.

305.

℞. Extracti belladonnæ 100
Morphinæ sulphatis 100
Olei theobromatis . . . . q. s.
M. Ft. suppositoriæ pro recto vj no.
Sig. — Morphine and belladonna.

306.

℞. Extracti belladonnæ 187
Morphinæ sulphatis 130
Olei theobromatis . . . . . q. s.
ut. ft. suppositoriæ pro vagina
sex numero.
Sig. — Morphine and belladonna.

Make by mold and by hand.

307.

℞. Unguent. hydrarg 2.0
Olei theobromatis . . . . q. s.
M. Ft. supposit. vj no.

Mix the ointment thoroughly with the melted butter and pour into well chilled molds.

308.

℞. Ext. carnis . . . . ʒ j
Pepsini . . . . ʒ ss
Pancreatini . . . . ʒ ss
M. Ft. suppos. vj no.
Sig. — Nutrient suppositories.

309.

℞. Paraldehyd . . . . ʒ iij
Ol. theobromat . . . . q. s.
M. Ft. suppositoriæ pro recto vj no.
Sig. — Use when needed.

Add half a drachm of spermaceti and q. s. cacao butter. If made by the cold process, melt the spermaceti, allow to partially cool, stir in the paraldehyde, allow to solidify, then incorporate with the cacao butter.

310.

℞. Iodoformi 1.000
Olei eucalypti 0.250
M. Ft. suppositoræ pro urethra iij no.

When a prescription calls for a number of suppositories that are liable to give trouble in molding, if the material is not too expensive, it is well to attempt to make more than the number called for in the hope of securing the required number in satisfactory condition at once. In this case attempt double the number, using equal parts of spermaceti and cacao butter as a base.

311.

℞. Acidi tannici	187
Acidi carbolici	187
Olei theobromatis	q. s.

M. Ft. suppositoriæ pro urethra no. iij.

Use cacao butter for hand method, and one-third spermaceti for hot process.

312.

℞. Camphoræ	gr. viij
Chloralis	gr. viij
Cetacei	ʒ ss
Olei theobromatis	gr. xv

M. Ft. pessarium.

Sig. — Headache discs.

313.

℞. Iodoformi	gr. xx
Bismuthi subnit	gr. xx
Olei theobromatis	q. s.

M. Ft. suppos. vj no.

Sig. — Use one 3 times daily as directed.

314.

℞. Salol	2.0
Olei theobromatis	q. s.

M. Ft. suppos. vj no.

Sig. — Salol suppositories.

If the cacao butter is heated enough to melt the salol when mixed (45° C.), the mixture will not harden readily.

315.

℞. Acidi borici	7.5
Gelatini	15.0
Glycerini	62.5
Aquæ	15.0

M. Ft. suppos. xl no.

Sig. — Boroglycerin suppositories.

Dissolve the gelatin in the water by heat, add the glycerin and boric acid, and, when clear, pour into molds.

CHAPTER XII.

OINTMENTS, CERATES, PLASTERS.

Ointment (Lat. *Unguentum-i*). — A fatty preparation of such a consistency as to be easily applied to the skin by inunction, gradually liquefying when in contact with it. (Cent. Dict.)

Cerate (Lat. *Ceratum-i*). — A fatty preparation resembling an ointment, but having a firmer consistency and a higher melting point. True cerates always contain wax (Cera).

Salve (Lat. *Chrisma, atis*). — A stiff ointment or cerate to be applied to wounds or sores.

Unguent. — A term applied mostly to perfumed salves or ointments used for anointing or for toilet purposes.

Plaster (Lat. *Emplastrum-i*). — A solid compound intended for external application, adhesive at the temperature of the human body, and requiring to be softened by heat before being spread. (Cent. Dict.)

Pomade (Lat. *Pomatum-i*). — A fat saturated with the odorous principles of plants by enfleurage; or a perfumed ointment or cerate used for the scalp and in dressing the hair.

These differ chiefly in their consistence and melting-points, the ointments being soft unctuous solids, which should partially melt when applied to the skin, the cerates stiffer, and having a slightly higher melting-point, and the plasters have just enough pliability to adhere to the skin, and offer a slight mechanical support and protection, as well as a medicative action through the absorption of medicinal matters contained therein.

They, with the true liniments, afford a gradation from the fluid oil-bases to the stiff waxy or resinous bases, any desired consistency and melting-point being obtained by mixtures of the oils, soft fats, waxes, and resins. They are all designed to produce an effect through the absorption of medicinal ingredients, in which they differ from the plasmas, which are designed for purely external or surface effects, medicinal matter not being absorbed from them to any extent.

Constitutional effects are often produced by the thorough rubbing-in of liniments or ointments, applied usually to the axillæ or groin, where the medicinal matters are more quickly absorbed.

Mercurials, narcotics, etc., can be made to produce their effects upon the system in this way, just as thoroughly as when taken by the mouth.

Professor C. S. N. Hallberg classifies these preparations therapeutically as:

1. **Epidermatic.** — Those which are intended to act only upon the surface of the skin. These are non-absorbent, and include such ointments and plasters as act as protectors, antiseptics, astringents, counter-irritants, germicides, and parasiticides. The best vehicle for these is petrolatum and paraffin.

2. **Endermatic.** — Those which are intended to penetrate *into but not through* the skin. These are semi-absorbent, and include such as act as emollients, anodynes, alteratives, resolvents, sedatives, stimulants and local irritants. The best vehicles for these are the vegetable oils and true fats, as lard, suet, almond or olive oil, etc.

3. **Diadermatic.** — Those which are intended to pass through the skin and produce constitutional effects. These are somewhat rare, and include *special uses* of mercurials, iodides, belladonna, conium, etc. The best vehicle for these is lanoline, or wool-fat.

Care must be taken to discriminate between the uses of these vehicles, particularly not to employ pure wool-fat when a systemic effect is not desired. But in combination with petrolatum the very-absorbent powers of wool-fat are reduced, and a mixture of equal parts of petrolatum and wool-fat corresponds closely, in therapeutic properties, to lard and the endermatic vehicles.

OINTMENTS AND CERATES.

The usual bases for these are lard, lard and wax, petrolatum and wool-fat. Oils stiffened with wax or paraffin have been used, but possess no special advantages, and are rarely ordered. Frequently the medicated jellies or glycero-gelatins are termed ointments. These are treated in the chapter on Plasmas.

The three principal bases, lard, or lard and wax, petrolatum and wool-fat, differ widely in character, both medicinally and pharmaceutically.

Each has the property of absorbing or emulsifying small quantities of water, but in different degrees, and they also vary in their absorbability and the promotion of medicinal action.

Lard (Lat., *Adeps*, gen. *Adipis*) is the prepared internal fat of the abdomen of Sus Scrofa, or hog, purified by washing with water, melting and straining. Much of the lard of commerce is not the abdominal fat, but the fat of the entire body of the hog, and differs from the official product in melting-point and consistence.

The abdominal lard, which should be used exclusively in pharmacy, is sold under the name of "pure leaf lard." This is sufficiently pure for making ointments, etc., but care should be taken that it does not contain salt or any excess of water.

When exposed to the air, lard soon begins to decompose and become "rancid." This gives it a strong and disagreeable odor, renders it incompatible with some chemicals, and causes an irritation when it is applied to the skin.

The tendency to become rancid is promoted by moisture and heat, so to guard against this the lard, and the ointments containing it, should be as nearly anhydrous as possible, and should be stored in a dry and cool place. To still further preserve it, the Pharmacopœia directs it to be saturated with benzoin, the volatile and antiseptic principles of which are soluble in the melted fat, and these retard change.

The best lard for pharmaceutical purposes is prepared directly from the leaf or flare.

Mr. A. W. Gerard gives the following directions for preparing a superior article: "Cut and bruise 100 parts of fresh leaf (deprived of its outer membrane) and heat in a deep vessel at 55° C. until the fat has melted and separated from its tissues. Add to the melted fat 6 parts of crushed benzoin, and continue the heat and stirring for twenty minutes. Finally strain, and gently press through flannel." If the leaf is bloody or otherwise dirty it should be washed and dried as thoroughly as possible before heating. The addition of a small piece of elm bark while melting aids in clarifying.

By trying out and benzoinating the lard in one operation freshness and sweetness is assured, and the ill-effects of a double heating avoided. A finely fragrant base is obtained by the above process, which is devoid of irritating properties and keeps well. Moreover, it demands little more labor than the official method of benzoinating a prepared lard.

The official method of benzoinating is to suspend the benzoin, coarsely powdered and tied in a muslin bag, in the top of the melted fat, and allow the hot fat to act upon it for two hours. It is more satisfactory to first mix the benzoin with an equal bulk of clean sand, thereby preventing its lumping together in the lard. Siam benzoin gives superior results, and is well worth its cost.

Several quick methods of benzoinating have been proposed, as the incorporating of a concentrated alcoholic or ethereal tincture, or an oily solution, made by dissolving two ounces of benzoin in four ounces of ether and evaporating the filtered solution in an ounce of castor oil, which may then be incorporated with the lard or with extemporaneous ointments.

When lard is incorporated with beeswax or resin, these act as preservatives, and benzoinating is less necessary. One per cent. resin is stated to be quite effective as a preserving agent. An easy test for rancidity is to make an ointment of potassium iodide without any hyposulphite of soda. If the lard is at all rancid, the ointment will become discolored in a short time.

Lard possesses the property of absorbing or emulsifying quite a proportion of water, 100 parts of lard, when cold, emulsifying 15 parts of water, and 100 parts of benzoinated lard taking up 17 parts of water, no other agent being necessary. This is a valuable property from a pharmaceutical standpoint, since it permits of the incorporation of soft extracts or aqueous solutions of salts.

Lard also yields up for absorption the medicinal agents which have been incorporated with it, and is therefore oftentimes preferred when a prompt and strong action is desired. These two valuable properties suffice to hold it in the first rank among the bases, in spite of its objectionable tendency toward rancidity.

The mixtures of lard and water are subject to the usual incompatibilities of emulsions, and it is rarely possible to incorporate as much of a saturated salt solution as of pure water. The range is wide enough for most purposes, however, and evaporation usually aids in incorporating troublesome fluids.

Petrolatum is the most unchangeable of the bases, being unacted upon by air, moisture or chemicals. When of a good quality, it is inactive in itself, but the commercial grades frequently contain some acid, used in purifying and bleaching, and, owing to this, are irritating.

It may be obtained of almost any consistence and fusing point—from the liquid petrolatum to the hard paraffin wax, melting at 45° to 65° C.

These are all similar in nature and composition, being derived from petroleum or "rock oil." They are useful as solvents, but do not mix well with aqueous fluids.

One hundred parts of petrolatum will absorb 5 to 10 parts of water.

It does not yield up for absorption medicinal agents very readily, and is hence adapted for ointments which are designed to act upon the surface only.

It is almost the opposite of lard, being permanent under ordinary conditions, taking up but little aqueous or alcoholic fluid, and retarding medicinal action.

The most troublesome feature in the use of petrolatum pharmaceutically is the difficulty of combining aqueous fluids with it. Thus it is unsuited for the preparation of such ointments as potassium iodide, etc. Many plans for overcoming this have been proposed, the best of which is the addition of yellow wax. Petrolatum containing 5 per cent. of yellow wax will absorb (or emulsify) 3 to 4 times as much water as pure petrolatum.

Wool-fat (*adeps lanæ*) is the purified fat of the wool of sheep, usually containing about 30 per cent. of water. It is not a pure fat, but a mixture of several fats with certain organic acids, esters and cholesterin, the latter being a solid alcohol, chemically considered.

It is a tough, unctuous solid, not as easily worked as other fats, but capable of dissolving or emulsifying an equal weight or more of water, and it does not easily become rancid. If exposed freely to the action of light, air and moisture, after several months it begins to decompose; but under ordinary conditions it will keep for a long time without a trace of rancidity. It is stated to be aseptic.

It is very quickly and freely absorbed by the skin, being very similar in character and composition to the fatty matter secreted by the sebaceous glands of the human body.

It affords a very useful vehicle for incorporating large proportions of liquids in ointments, suppositories, etc., but is not a good vehicle for the incorporation of insoluble powders or bulky solids.

Its stickiness is also objectionable.

This stickiness is partly overcome by the addition of a small proportion of petrolatum. A mixture which has been proposed as particularly free from stickiness is: anhydrous lanoline, 65 parts; liquid petrolatum, 30 parts; ceresin, 5 parts; water, 30 parts. The ceresin is melted and stirred into the liquid petrolatum, then this mixture is added to the anhydrous lanoline, and finally, the water is incorporated.

Commerical wool-fat contains about 30 parts of water, which may be removed by evaporation, if desired.

Other bases which are commonly associated with the preceding as diluents or stiffening agents are:

Beeswax (*Cera*) either bleached or unbleached. The latter is a better preservative and is purer. White wax always contains a little foreign fat, and these are frequently rancid and cause the lard in ointments to become rancid also. Beeswax melts at 63° to 66° C.

Suet (*Sevum*), the abdominal fat of the sheep purified in the same manner as lard. This is much firmer than lard, and does not become rancid as easily. Suet melts at 44° to 50° C.

Spermaceti (*Cetaceum*) is a crystalline wax-like substance obtained from the head of the sperm whale. It becomes yellowish and rancid on exposure to air. It melts at or near 50° C.

Resin or Colophony (*Resina*), also called "rosin," is a sticky solid obtained as a residue from the distillation of oil of turpentine.

Its melting point varies, usually above 100° C.

Paraffin or waxy petrolatum, white, hard, and melting at 45° to 80° C.

Besides these, other fats are sometimes called for in domestic practice which are supposed to possess peculiar virtues. Goose-grease is readily absorbed and popular for inunction.

Mixed with one-sixth its weight of cacao butter it makes a firm base.

Skunk oil, bear's grease, porpoise oil, rabbit fat, rattlesnake oil, and many other of similar character are superstitiously regarded. Probably all of these are grossly adulterated or sophisticated.

Starch is used to stiffen ointments and make them more salve-like without raising the fusing-point. It is employed mostly in ointments having petrolatum for a base and insoluble powders as the active medicament, as zinc oxide. It also promotes a closer adherence of these to the skin.

Superfatted soaps (*i. e.*, soaps containing an excess of oil or fat) have been proposed as bases, the advantages being their freedom from rancidity and from irritating properties, good keeping qualities, ready admixture with medicinal matter, and easy removal from the skin by warm or cold water. The following illustrate them:

Mollin is the name applied to a base prepared by saponifying, without heat, 100 parts cocoanut oil or of fresh fat with 40 parts of a 15 per cent. solution of caustic potassa, mixing intimately with 30 parts of glycerin and heating carefully. This makes a yellowish, smooth and soft base.

Sapo unguinosus or sapo leniens is prepared by converting 100 parts of pure potassium carbonate into caustic potash, with 60–80 parts of quicklime, the solution being concentrated to sp. gr. 1.180; 400 parts of lard are added, the mixture stirred for half an hour, 40 parts of alcohol added, and the whole digested 12 hours in a covered vessel at 50°–60° C.; then 150 parts of glycerin added.

These bases are suited as vehicles for organic bodies, as balsam of Peru, phenols, sulphur, etc., but are incompatible with metallic salts, oxides and acids.

A mixture of doegling oil with wax has been proposed. This oil does not easily become rancid, and is readily absorbed by the skin. In order to make such a base miscible with aqueous fluids, soap may also be incorporated.

Under the name of "**myronin,**" such a base is prepared by mixing sufficient carnauba wax with doegling oil to give an ointment-like consistence; then incorporating 10 or 20 per cent. of stearine soap (stearate of potassium).

Unguentum Caseini.—Dr. Unna, the originator of this new ointment-base, gives the following directions for its preparation: Take milk from which the cream or fat has been entirely removed, and curdle it by the addition of rennet at a temperature of 30° to 40° C. Assemble the coagulum and wash with running water until the washings no longer show an acid reaction; dry carefully and reduce to powder. Dissolve 34.5 parts of caustic potassa and 8.5 parts of caustic soda in 5,000 parts of water, and dissolve 1,400 parts of casein in this solution. Now add 700 parts of glycerin and 50 parts of carbolic acid, and, when these are dissolved, incorporate 2,100 parts of vaselin and 50 parts of zinc oxide, and finally add enough water to make 10,000 parts. Thus prepared, casein ointment presents a perfectly homogeneous, semi-liquid, durable emulsion, which is, in fact, a sort of thick and artificial milk, the vaselin being in a condition of the minutest subdivision. It forms a soft and pliable film upon the skin, and is free from greasiness. Acids and acid salts are incompatible with it, coagulating the casein and causing separation of the base; but medicaments with only a slightly acid reaction which can be emulsionized, as tar, balsams, etc., can be incorporated to the extent of 20 per cent. Alkalies and alkaline salts, ichthyol, etc., thicken the base and the addition of more water becomes necessary. Metallic mercury can be incorporated to the extent of 33 per cent. Powdered substances may be first rubbed up with a little vaselin and then incorporated with the base.

The following table, prepared by A. St. Onge, shows the relative absorptivity of the different bases when manipulated in the usual manner. The figures are not absolute, but show the results of a series of carefully conducted experiments, and may be relied upon for guidance at the prescription counter:

100 Parts of Base.	Amount of Water.	Amount of Alcohol.	Amount of Glycerin.
Lard	15	9.05	100
Benzoinated Lard, U. S. P.	17	8.36	100
Lard with Tr. Benzoin	17		
Lard with 1 per cent. Benzoic Acid	12	6.22	80
Lard with Balsam Tolu	17		
Lard with Balm Gilead	17		
Lard with 5 per cent. Glycerin	10	9.85	95
Lard with 2 per cent. Resin	22	10.80	75
Lard with 10 per cent. Vaselin	4	4	50
Ointment	40	11.49	200
Cerate	40	13.25	100
Spermaceti Cerate	30	9.69	80
Cold Cream	50	5.68	300
Cocoanut Oil	100	54.8	50
Goose Oil (6) with Cacao Butter (1)	30	47.94	200
Goose Oil (6) with Yellow Wax (1)	100	37.67	600
Petrolatum	10	5.72	100
with 5 per cent. Yellow Wax	40		
Cosmolin	15	8.54	100
with 5 per cent. Yellow Wax	55		
Lucillin	12	6.09	100
with 5 per cent. Yellow Wax	35		
Vaselin	12	11.14	100
with 5 per cent. Yellow Wax	65		
White Vaselin	10	9.44	150
with 5 per cent. White Wax	60		
Albolin	2	2.82	25
with 5 per cent. White Wax	15		
Mollosin	112	14.50	100
Lanolin	200	8.14	200
Agnin	200	200	100
Anhydrous Wool Fat	300	7.5	300
Lanolin Ointment	150	8.86	200
Unguentum Lanolin	300	9.40	300
Adipatum	400	11.88	400
Epidermin	Indefinite	50	Indefinite
Mollin	Alm Indefinite	5.36	"
Casein Ointment	Indefinite	10 fluid 25 breaks emulsion	"

Oleates and Stearates. — The oleates are often employed in ointments in preference to powdered chemicals, as they are more readily absorbed. Professor Hallberg states that they penetrate into, but not through, the skin. Some of these are adapted to extemporaneous preparation, and merit mention here.

The true oleates are salts prepared with oleic acid, but all of the official oleates contain an excess of oleic acid, being prepared by dissolving the alkaloid or metallic oxide in the acid.

This is the method always chosen for making oleates of the alkaloids, and but little time is required. Oleic acid varies much in quality as found in the market, and it is desirable that only the purest should be used in preparing these, to avoid irritating qualities.

A light-colored acid is selected by preference, but purity and freedom from rancidity should be the prime requisites.

The free alkaloids (not the salts) are readily soluble in this. Solution is hastened by heat, but the oleate so made does not keep as well. The usual strength is 2 per cent. of alkaloid, except morphine 5 per cent. and quinine 25 per cent.

None keep well, and they should be made fresh.

The metallic oleates may be prepared in the same manner by dissolving the oxide in the acid. Heat and moisture favor the solubility, but hasten decomposition.

It is preferable to make these by double decomposition with a specially prepared sodium or potassium oleate. On adding a soluble metallic salt to this, the corresponding oleate is precipitated as a soft unctuous mass, which is then washed and dried. These keep much better than when an excess of acid is present, and may be diluted to any strength desired.

If made with stearic acid instead of oleic, a fine powder is obtained instead of an unctuous mass.

Castile soap is sometimes used in place of sodium oleate, and an oleopalmitate is precipitated instead of a pure oleate.

Such are firmer than the true oleates, and may be stiff and plastic-like, as lead plaster, or pulverulent, as the commercial "oleate of zinc," so-called. Both of these may be made in this way.

PREPARATION OF OINTMENTS. — Ointments are prepared by two general methods — mechanical mixing of the ingredients, or by fusion.

The first method is used when soft fats are mixed with insoluble bodies, the second method when waxes, resins, etc., are to be mixed with soft fats, or when medicinal ingredients are to be incorporated which are soluble in the warm fats; also to facilitate mechanical mixing.

Mechanical incorporation may be performed by trituration in a mortar, or on a glass slab by means of a broad and stiff spatula. The latter method is generally the better, except when a considerable amount of liquid is incorporated. It has this advantage, that lumpy particles are more easily pressed out. Ointments are also more easily and thoroughly transferred from a slab than from a mortar and pestle. A glass slab is to be preferred, because it is non-absorptive and readily cleansed. Two of these are convenient, the under sides being painted respectively black and white, then light-colored ointments are made over the dark background, and dark-colored ointments over the light, the condition of the mixtures being in this way easily watched. A steel spatula or putty-knife may be used in most cases when water is not present, since reactions of salts do not occur readily through the medium of fats.

It should not be used with citrine ointment, however, as this contains some nitric acid, nor with other mercury salts, tannin, etc., when water is present.

Mortars are preferred when much liquid is to be incorporated, or sometimes when a very hard ointment or cerate is to be mixed with a soft one. In such cases the hard or stiff ointment should be first triturated with a small quantity (one-half to an equal bulk) of the soft body until thoroughly admixed, then the remainder is added and incorporated. During the first mixing the hard fats will become somewhat softened by the triturations and the mixing is easier. If this is not done, lumps are formed in the mixture which are difficult to eradicate.

The same method should be followed when the mixing is performed on a slab.

Heat aids the mixing or incorporation very considerably, whether a mortar or a slab be used, by softening the fats and rendering the work easier. It also favors the solubility of bodies which are soluble in fats and oils. Many think that the incorporation of insoluble substances with melted fats makes a superior ointment, as well as being easier.

The easiest way to warm a mortar or slab is to wet the surface with alcohol and set it afire. Only a very little alcohol is needed.

Relatively large quantities of liquids are best incorporated by adding them gradually to the fatty base, with constant trituration, as in making emulsions, or by first melting the fats and stirring in the fluid as the base cools. Such ointments are usually white and creamy, and more prone to spoil.

Glycerin and oils mix more readily in a warm mortar.

Extracts should always be softened before adding to fats or oils; aqueous extracts with water and alcoholic extracts with diluted alcohol. Alcohol is less readily incorporated than water.

Certain fluid and semi-fluid bodies, as balsam of Peru, storax, tar, ichthyol, etc., are difficult to incorporate with fats, and they separate in a granular form on standing. These are sometimes ordered in relatively large proportions, and are difficult to incorporate. By emulsifying them first with half their weight of yolk of egg, the mixing is facilitated. But yolk of egg must not be used with carbolic acid, resorcin, or other substances that coagulate albumin.

Regarding the incorporation of liquids with ointments, Mr. A. St. Onge makes the following statement:

"Water when mixed with a base gives it a white and creamy appearance; alcohol does not whiten the base nor change the color, and glycerin makes a mass more or less translucent.

"The length of time taken to incorporate the base with the liquid must necessarily vary. When the proportion of liquid is small compared with the base as in the case of lard and petroleum jellies, a minute or two is sufficient for complete saturation; bases that absorb from 35 to 65 parts of liquids can be saturated within 15 to 20 minutes, whilst wool fat cannot be saturated within a reasonable time; it is not due so much to excessive amount of certain liquids that it will take as to its ropiness and stickiness, and its large increase in bulk when being saturated. Fats diminish the stickiness of wool fat and also its tendency to enormously increase in volume when incorporated with water.

"Bases saturated with water will not take glycerin and vice versa; water and glycerin can be used, however, in the same base. A base saturated with alcohol will take up water without the breaking of the mixture.

"**When two or more liquids** are to be incorporated into a base, their previous admixture seems to work better than the separate incorporation. Saturated bases with liquids are not permanent mixtures, the water and alcohol evaporating upon exposure, whilst glycerin has a tendency to separate upon standing; the glycerin appearing as fine globules all through the mass, and the mass becoming readily homogeneous upon stirring. Fats mixed with liquids within two-thirds of the saturating point are comparatively stable.

"Ointment bases containing white or yellow wax and the white paraffin jellies, when saturated with water, will grow darker upon standing."

Powders which are insoluble in the fats or only slightly soluble in water must be first thoroughly incorporated with about an equal bulk of the base before the remainder is added. If in large proportion this is best accomplished in a warm mortar, even warm enough to melt the fat, and the trituration must be continued until the two are well mixed and no lumpy or gritty particles can be discovered. The remainder of the fat can now be very easily incorporated either as a liquid or a solid, and a smooth ointment results.

The mortar is easily heated by filling with hot water and allowing to stand a few minutes, or by burning half a drachm or so of alcohol in it.

Gritty ointments are an abomination to pharmacy, and are often mischievous when applied to a sensitive and sore surface. A pharmacist should never allow an ointment to leave a dispensing counter until it is perfectly smooth and homogeneous, when it may be soothing instead of irritating. This is not always easily accomplished, or rather quickly accomplished, sometimes requiring patience and plenty of muscle, but it is always worth the while.

There are now in the market mixtures of zinc oxide with benne oil made by grinding the two together in a paint-mill, thereby insuring a perfectly smooth though stiff paste. These may be used in place of the dry powder, but in making small quantities but little time will be saved by their use and the resulting ointment will be softer.

In some of the mercurial ointments, the salt is first rubbed to a fine powder with a little oil, partly for the above reason, and partly because these are liable to be reduced by friction if an attempt is made to powder them finely while dry.

Crystalline salts must first be rubbed to a very fine powder, or in case they are very soluble, as potassium iodide, etc., dissolved in a little hot water, except in case of eye-salves, when any risk of minute crystals, which are liable to form in the hot solution before it can be thoroughly diffused, must be avoided. Minute and sharp crystals are exceedingly irritating, and special pains should be taken to avoid them.

When water is inadmissible for this or other reasons, a few drops of oil may be employed. Eye-salves containing crystalline alkaloids are particularly troublesome in this regard. Water should not be used for dissolving the crystals. The oleates of the alkaloids are better when permitted by the physician, but care should be taken that these are fresh and free from rancidity. In lieu of these the salts should be triturated thoroughly with a little oil or a portion of the base, until rubbed to an impalpable powder.

In preparing large quantities of ointments containing insoluble powders in large proportion, it is often more expeditious to partially incorporate the powder with the melted base, then rub the hot mixture through cloth, taking care that all the powder goes through with the fat. The strained mass should then be well stirred while cooling.

This plan of rubbing a soft ointment through a cloth works well with lumpy substances in small quantities, and may save much time.

Preparation by Fusion. — When wax, stearin, rosin, or other hard fusible bodies are to be incorporated with soft fats, it is necessary to melt both these and the soft fats to get a smooth, homogeneous mixture. Such mixtures have a melting point intermediate between those of its ingredients, and, if the quantities are equal, usually nearer to the lower point than the higher. The fusing point cannot be calculated, but must be ascertained by experiment, if desired.

In mixing these bodies the invariable rule to be followed is to *melt the body having the highest fusing point first, then add that having the next highest.*

Never place the cold ingredients together in a pan or capsule and try to melt all at once, because when this is done it is necessary to heat the entire mass to the fusing point of the highest body before all will be melted, and more time and labor are required to secure a smooth fat from this hot liquid. When wax, spermaceti, and stearin are thus mixed with softer fats, it is necessary to stir the warm fluid while cooling to prevent congealing in a granular condition. Do not attempt to chill rapidly while doing this, or the hard fats and waxes are likely to separate, and require re-melting.

The operation is best performed by melting each body very slowly, then the fluid as first obtained will be near its congealing point and begin to solidify in a short time.

It is not necessary to continue stirring until the mixture is hard, but only until a pasty mass is obtained which is just stiff enough to prevent the separation or settling of the hard fats or insoluble powders. If continued beyond this, air is worked into the ointment, and it is more likely to spoil on keeping.

Resin and cacao butter do not have this tendency to separate, and stirring is therefore unnecessary.

It is possible to make wax-ointments also without stirring, but special care and watching are needed to see that the liquid does not get too hot, and little time or labor is saved. If the conditions are just right granulation will not occur, otherwise it will.

When bodies which are soluble in oils are to be incorporated in ointments and cerates, dissolving them in the melted base is often the best method.

Many of such bodies are volatile or injured by heat, and an excess of heat should always be carefully avoided.

The heat is best applied by means of a water-bath, and the fat should not be melted too quickly. If the fat is not perfectly clear it should be strained before adding the medicinal agent.

When more of the soluble body is to be incorporated than will dissolve in the base, it is preferable to incorporate the whole mechanically.

Chemical changes occur not very frequently in the making of ointments and cerates. This is illustrated in only one each of the official cerates and ointments.

In ointment of nitrate of mercury, elaidin is formed by the action of nitric acid upon lard, and mercury nitrate by the union of mercury and nitric acid.

This is not within the bounds of extemporaneous pharmacy and a full discussion is out of place here. The official process will give satisfactory results if carefully followed, provided the nitric acid is of *full strength.*

In Goulard's cerate, a reaction takes place between the subacetate of lead and the fats in the camphor cerate, lead soap or plaster being formed. This will not keep well, and should be made fresh each time.

STORING AND DISPENSING.

Comparatively few of the ointments are permanent preparations. Those made of lard or suet tend to become rancid in a short time, and those made with petrolatum separate easily if stored in a slightly warm place.

Many of them change in color by action of light; citrin, chrysarobin, mercurous iodide, iodoform ointments and many others becoming dark, while iodine ointment first darkens, then becomes lighter. Ointments containing extracts of Peru balsam, tar and others separate on standing even if kept cold. Some metallic salts are reduced and some are oxidized, on standing in contact with fats, particularly if water is present.

Cerates are more permanent as a class, but some of these spoil quickly, notably Goulard's cerate.

All such should be made fresh as called for, or only in such quantities as will be quickly disposed of.

Ointments and cerates should always be stored in the coolest and dryest available place. If kept in a warm place, the softening of the base is likely to cause a partial separation of the ointment; heat and moisture also favor chemical changes. When dispensed the patient also should be directed, either by labelling the box to that effect or verbally, to keep it in a cool place.

The best containers are those of amber or opaque glass, both for storing and dispensing. Earthen-ware containers are usually somewhat porous, and if a rancid ointment be once stored in them, they are not easily purified.

Pots with rounded inside surfaces, no sharp corners, are most convenient for removing the ointment for use, and they are also more easily cleaned.

Never mix a new ointment with the remains of an old lot, particularly when made of a vehicle liable to become rancid. The old ointment should be thoroughly removed from the pot before any of the new is inserted. The cleaning can be easily accomplished by rubbing with pine or other soft-wood sawdust, or with soft paper, then washing with caustic potash or ammonia-soap solution. This method is also useful for cleaning utensils with which ointments have been made.

Rather than take the trouble to clean the container each time an ointment is renewed, some prefer to use the cheaper chip boxes made of successive layers of wood veneer.

These are almost impervious, and are cheap enough so that a new box may be dispensed each time. The turned-wood boxes are practically worthless, as the fat quickly permeates the wood, and they become very disagreeable to handle.

In labelling the boxes the number of the prescription should be placed both on the top and bottom, so that if one label becomes obliterated or lost, the other will suffice for renewal.

Very soft ointments may be daintily dispensed in **collapsible tubes** such as are used for glycerin jellies, etc. Avoid putting a hard or stiff ointment into such.

The easiest way to fill a collapsible tube is to roll the ointment into a tube of stiff paper, insert one end of this into the open end of the collapsible tube, then draw the paper through the fingers so as to squeeze out the ointment and leave it in the tube.

Cerates are sometimes ordered to be spread like a plaster, particularly cantharides cerate. A little heat, sufficient to soften, but not melt the cerate, is admissible in such cases, but *hot* tools should not be used.

PLASTERS.

The making and spreading of plasters is a much less frequent operation now than it was twenty years ago, before the era of the rubber and porous plasters. Plaster-making was then an important part of pharmacy, requiring a skill to acquire which much practice was necessary. At the present time the art is restricted mostly to the preparation and spreading of blistering plasters, and even these are not very frequent. Plasters are still largely used, but the demand is supplied almost entirely by manufacturers who use a rubber and resin basis.

It is questionable if medicines are absorbed from this base as readily as from fats and resins without the rubber, and a number of plasters are still official.

The bases of these are medicinally more active than those of ointments and cerates.

Lead plaster, which is essentially lead soap, is one of the most common. This has a sedative and mildly astringent action. Mixed with soap its action is still milder.

Resin and pitch have a stimulating action and impart adhesiveness.

Wax is used merely to impart firmness and is not often used.

Gum resins and oleoresins are stimulating and also impart adhesiveness.

The purpose of plasters is two-fold; to afford protection and mechanical support, and to produce medicinal effects by slow absorption.

For the first reason plasters are always hard and possess little adhesiveness when cold. For convenience of handling they are made into the form of sticks or rolls, which may be protected from the air by wrapping in oiled or paraffined paper.

In only a very few cases are plasters soft enough to be handled conveniently in mass.

Plasters with fatty or soap bases should never be kept already spread, as they become brittle and discolored.

Preparation of Plasters. — Plasters are always made by fusion or solution.

By fusion the process is very similar to the making of cerates, etc.

The body having the highest melting point is fused first, then the others are added in order and lastly the medicinal ingredients.

If straining is necessary it should be done before the medicinal matter is added. When these are soluble in the plaster ingredients the mass is kept fluid, at as low a temperature as possible, until the medicinal matter is all dissolved, and thoroughly mixed with the base. Alcoholic extracts are better adapted for plasters than aqueous, for this reason. If the extracts are injured by heat they should be diffused or incorporated as quickly as possible, but with the least heat.

Volatile bodies, as menthol, camphor, etc., are to be treated in the same way.

Insoluble powders, etc., are stirred into the mass while cooling.

The mass should be rolled into sticks while still warm. This is easily done on a glass or porcelain slab by rolling with the hands, or with a flat stick of wood. If the mass contains much resin or pitch, a little petrolatum will prevent its sticking to the hands and utensils. Lead plaster does not need this. This should be kneaded thoroughly before rolling to work out the excess of water. If left in the mass the plaster appears whiter, but it oxidizes more quickly and does not make as nice a mass when mixed with other bases.

Resinous plasters may sometimes be whitened by pulling and kneading, air being worked into them in this way.

The sticks can be made of any convenient size, usually of a size to fit the can or bottle in which they are to be stored.

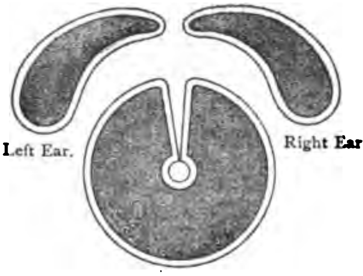
Spreading. — Plasters are spread upon skin, silk, cotton cloth or paper.

The large plasters are best spread upon sheep or chamois skin, but cotton cloth will serve nearly as well if the customer does not care to pay for the skin. Small plasters are spread upon thin cloth or brown paper, sometimes upon flexible adhesive plaster, which is sold for this purpose by plaster manufacturers.

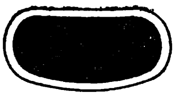
The design is first marked upon a piece of cardboard and then cut out, making a stencil form, which is placed over the skin or cloth and filled in with the plaster. The form should have a wide margin, and by preference should be of the same thickness as the desired plaster. It may be tacked upon the cloth, or, if first dipped into water, it will adhere fairly well in the moist condition and will not interfere with the spreading.

Forms are kept, of tinned iron or sheet zinc, in some cases. These are very useful for ear plasters, but the others are likely to vary in size, as ordered. It will be found easier to cut or trim the cloth upon which the plaster is placed after spreading.

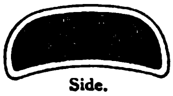
The plaster is melted in a convenient dish, poured upon the cloth while hot, and spread over its surface with a few rapid strokes of a large spatula or plaster-iron, previously heated. Plasters which have been spread slowly usually have a crinkly or striped surface. They are much more apt to be smooth and of an even thickness if spread rapidly.



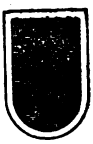
Breast.



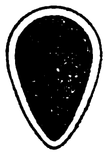
Back and Kidney.



Side.



Shoulder.



Chest.

The plaster should not be hot enough to soak through the skin or cloth and stain the under side, and the spreading spatula should be only warm enough to obviate congealing the soft mass. Plaster-irons may be obtained which will retain their heat for a long time or which are self-heating.

Hollow rollers are also used which may be kept filled with hot water, and are useful for giving a smooth finish, but are not good for spreading.

Cantharides cerate should be spread with a warm spatula or iron, but without melting.

The cloth should not be trimmed close to the plaster; a margin of half an inch or so should be left all around.

Ear-plasters may be trimmed close on the inner edge where it fits against the back of the ear, a margin being left on the remaining sides.

A sheet of tissue or oiled paper should be placed over the surface of the plaster before dispensing; then the plaster may be placed in a box or formed into a roll.

Rubber plasters are essentially an American industry of comparatively recent date. The basis of these is a mixture of best Para rubber with olibanum (true frankincense), pitch, wax, etc., worked together entirely by mechanical means. Attempts were made in the early days of the industry to use solvents for incorporating these and obtaining a homogeneous mixture, but these failed, the rubber never being itself again after solution.

The rubber is first soaked and steamed; then passed through spirally corrugated iron rolls, under a stream of water, until well cleansed.

This forces it out in crinkled sheets, which are hung up to dry and "season." The freshly-exposed surfaces are a very light brownish-yellow at first, but exposure to the air soon turns them dark and even black.

The sheets are then worked on warm, smooth calender mills to a perfectly homogeneous mass.

The olibanum, or frankincense, to which the fragrant odor of these plasters is mostly due, is stamped and sifted, while the pitch and wax is purified by melting and straining.

The ingredients are then mixed by working on the warm calender mills, and the medicinal ingredients are incorporated in the same way. The mass is spread, while still warm and plastic, by means of heavy calenders. The cloth, measuring usually 120 yards by 36 inches, is fed through the calenders, and passing under the lower roll, is connected with a large reel behind the machine. The calenders being gauged for the right thickness are started and the mass fed upon the cloth, between guides.

After standing for a time upon the reels, to cool and harden, the plaster is wound upon wooden drums, cut into strips the width of the finished plaster, and these are afterwards cut transversely and perforated. About 100,000 plasters may be spread per day on one machine.

These plasters are very flexible, and adhere well to the skin, the medicinal qualities being readily absorbed. When of the best quality, they retain their flexibility for a long time; but some grades will become brittle and non-adhesive after a time.

These can be temporarily restored by warming and wetting with spirit of camphor, or with a bland oil.

The rubber being the most expensive ingredient, attempts have been made to find a substitute for it; but the flexible and adhesive qualities cannot be satisfactorily secured without this. Among the materials suggested are chicle, vulcanized oil, varieties of asphaltum, and a base consisting of glue, glycerin, and an alkaline sulphoricinoleate.

OINTMENTS, CERATES AND PLASTERS.

316.

℞. Ammoniated mercury, in very fine powder	10 Gm.
Petrolatum	90 Gm.

M. Sig. — White precipitate ointment.

Rub the ammoniated mercury with the petrolatum gradually added, until they are thoroughly mixed.

Make 20 Gm.

317.

℞. Red mercuric oxide, in very fine powder	10 Gm.
Distilled water	10 Gm.
Lanolin, anhydrous	40 Gm.
Petrolatum	40 Gm.

M. Sig. — Red precipitate ointment.

Triturate the red mercuric oxide with the water, then with the lanolin, until smooth, then gradually incorporate the petrolatum and mix thoroughly.

Make 20 Gm.

318.

℞. Potassium iodide	10 Gm.
Potassium carbonate	0.6 Gm.
Water, hot	10 C.c.
Benzoinated lard	80 Gm.

M. Sig. — Potassium iodide ointment, U. S. P.

"Dissolve the potassium iodide and the potassium carbonate in the hot water, then mix the solution with the benzoinated lard."

Make 20 Gm.

319.

℞. Iodine	4 Gm.
Potassium iodide	4 Gm.
Glycerin	12 Gm.
Benzoinated lard	80 Gm.

M. Sig. — Iodine ointment, U. S. P.

"Rub the iodine and the iodide of potassium, first with the water, and then with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of a metallic spatula. This preparation should be freshly made, when required."

Make 20 Gm.

320.

℞. Extract of stramonium leaf	10 Gm.
Diluted alcohol	5 C.c.
Lanolin	20 Gm.
Benzoinated lard	65 Gm.

M. Sig. — Stramonium ointment, U.S.P.

"Rub the extract with the diluted alcohol until it is uniformly soft; then gradually add the lanolin, then the benzoinated lard, and mix thoroughly."

Make 20 Gm.

321.

℞. Lead plaster	50 Gm.
Olive oil	50 Gm.
Tincture of benzoin	10 C.c.

M. Sig. — Diachylon ointment, U. S. P.

"Melt together the lead plaster and the olive oil, on a water-bath; then add the tincture of benzoin, continue the heat until the mixture weighs 102 Gm. and then remove from the heat and stir until the ointment congeals.

Make 25 Gm.

322.

℞. Washed sulphur	15 Gm.
Benzoinated lard	85 Gm.

M. Sig. — Sulphur ointment.

Rub the sulphur with the lard gradually added until they are thoroughly mixed.

323.

℞. Zinc oxide	20 Gm.
Benzoinated lard	80 Gm.

M. Sig. — Zinc oxide ointment.

Rub the zinc oxide with an equal weight of lard in a warm mortar until smooth, then incorporate the rest of the lard.

324.

℞. Zinc oleate	50 Gm.
Petrolatum	50 Gm.

M. Sig. — Zinc oleate ointment.

Heat them together on a water-bath until the oleate is dissolved in the melted petrolatum, then remove from the heat and stir until it congeals.

325.

Mercury	50 Gm.
Mercuric oleate	2 Gm.
Suet	23 Gm.
Benzoinated lard	25 Gm.

Triturate the mercury with the mercuric oleate until the mercury is emulsified. Melt the suet, add the lard, and allow the mixture to partially cool. Add about 3 Gm. to the mercury mixture, and triturate until the globules of mercury are no longer visible, then gradually add the remainder of the fats and continue the trituration until the ointment has become of a deep bluish color.

326.

Spermaceti	125 Gm.
White wax	120 Gm.
Expressed oil of almond	560 Gm.
Stronger rose water	190 C.c.
Sodium borate, in fine powder	5 Gm.

M. Sig. — Cold cream, U. S. P.

"Reduce the spermaceti and the white wax to fine shavings, and melt them at a moderate heat. Then add the expressed oil of almond, pour the mixture into a warmed, shallow Wedgwood mortar, carefully add, without stirring, the whole of the stronger rose water in which the sodium borate had previously been dissolved by a gentle heat, and stir rapidly and continuously, until the mixture becomes uniformly soft and creamy." Make one twentieth the above quantities. In larger quantities this is best stirred with a "Dover" egg-beater. Do not stir too long.

327.

℞.	Ceræ albæ	14.0 Gm.
	Adipis lanæ	3.5 Gm.
	Petrolati liquidi	55.0 Gm.
	Aquæ rosa	27.5 Gm.

M. Sig. — Toilet cold cream.

Melt the wax, add the lanolin, then the liquid petrolatum, and lastly add the rose water and stir until it congeals.

328.

℞.	Ceræ albæ	16.2 Gm.
	Petrolati liquidi	58.0 Gm.
	Sodii boratis	0.8 Gm.
	Aquæ rosæ	25.0 Gm.

M. Sig. — Permanent cold cream.

Melt the wax, add the liquid petrolatum, then stir in the rose water previously warmed and containing the borax. Stir until the whole congeals.

329.

℞.	Adipis	℥ viij
	Ceræ flavæ	℥ ss
	Cetacei	℥ ss
	Sodii boratis	ʒ ijss
	Cucumeri	iij No.

M. Sig. — Cucumber cream.

Melt together the lard, wax and spermaceti and stir while cooling. Peel and slice three (fair-sized) cucumbers, and mix with the ointment, with which half the borax has been incorporated. Allow to stand 10 hours, then melt, strain, chill on ice and separate the watery layer, and incorporate the remainder of the borax.

330.

Resin cerate	650 Gm.
Oil of turpentine	350 Gm.

M. Sig.—Turpentine liniment, U. S. P.

"Melt the resin cerate in a capsule, on a water-bath, then add the oil of turpentine, and mix them thoroughly."

Make 20 Grams.

331.

℞.	Zinci oxidi	1.0
	Camphoræ	0.150
	Unguenti	20.0

M. Ft. ungt. Sig. — Eye salve.

Melt half the ointment and dissolve the camphor in the warm fat, incorporate the zinc oxide, then the remainder of the ointment.

332.

℞. Cocaine hydrochloratis . . . . ʒ ss
Petrolati . . . . ℥ j
M. Sig. — Apply to the eyes.

333.

℞. Hydrarg. chlorid. corros. . . Gr. iij
Petrolati . . . . ℥ j
M. Ft. ung.

Dissolve the corrosive sublimate in 30 minims of alcohol, mix this with a drachm of castor oil, then incorporate 7 drachms of petrolatum, avoiding contact with a steel spatula.

334.

℞. Thymol . . . . ʒ j
Adipis benz . . . . ℥ j
M. — Ft. ungt.

Melt the lard, dissolve the thymol therein, and stir while cooling.

335.

℞. Ung. hydrargyri,
Ung. aquæ rosæ . . . . . āā 10.0
M.

336.

℞. Ung. hydrarg. nit.,
Ung. aquæ rosæ . . . . . āā 10.0
M.

Work cautiously, and avoid the use of metallic implements.

337.

℞. Camphoræ,
Chloralis . . . . āā 4
Petrolati 15
M. Ft. ung. Sig. — Ad partem dolentem applicetur.

Triturate the chloral and camphor together in a mortar until completely liquefied, and add the petrolatum.

338.

℞. Ext. eucalypti,
Ext. hydrastis,
Ext. irid. versic . . . . . . āā ʒ j
Petrolati . . . . ℥ j
M. Ft. ung.

Soften the extracts with glycerin, and mix with the petrolatum. Water or alcohol, if used for softening, does not mix well with the petrolatum.

339.

℞. Ext. phytolaccæ bac. fld. . . . ℥ j
Adipis . . . . ℥ j
M. Ft. ung.

Melt the lard, add the fluid extract and stir while cooling. A smooth ointment results without previous evaporation of the fluid extract.

340.

℞. Pulv. sodii boratis . . . . . . ℥ ss
Calcii hyposulphit . . . . . . ʒ j
Glycerini . . . . ℥ j
Petrolati . . . . ℥ ij
M. Ft. ung.

Dissolve the borax in the glycerin by aid of heat, stir in the calcium hyposulphite, previously powdered, then incorporate with petrolatum.

341.

℞. Naphtoli	2
Petrolati	20

M. Ft. ung.

Dissolve the naphtol in 3 C.c. of ether and mix with 5 Gm. of petrolatum. Warm on the water-bath until the ether is entirely expelled, stirring the while, then incorporate the remainder of the petrolatum. Aristol ointment may be made in the same way.

342.

℞. Aristol	5.00
Petrolati	45.00

M. Ft. ung.

Rub the aristol to a smooth cream with an equal weight of almond oil, then incorporate 40 Gm. of petrolatum, gradually added.

343.

℞. Resorcin	ʒ ss
Zinci chloridi	gr. x
Petrolati	℥ j

M. Ft. ung.

Rub the resorcin and zinc chloride with half a drachm of alcohol, and incorporate the petrolatum.

344.

℞. Acid salicylic	ʒ ij
Menthol	ʒ ss
Olei gaultheriæ	ʒ ij
Adipis lanæ	ʒ iv
Petrolati	ʒ iv

M. Ft. ung.

Dissolve the salicylic acid in a little ether, mix with the petrolatum and warm gently until the ether has evaporated. Mix the oil in which the menthol has been dissolved with the lanolin, then mix with the petrolatum mixture.

345.

℞. Phenoli	1.0
Unguenti	19.0

M. Ft. ung.

This is best made by dissolving the phenol in the warm ointment and stirring until cold.

346.

℞. Olei amygdalæ expres	4
Cetacei	8
Ceræ albæ	4
Camphoræ	1

M. Sig. — "Camphor ice."

Mold in glass tubes.

347.

℞. Adipis lanæ hydros	5.0
Sulphuris præcip	5.0
Zinci oxidi	2.5
Ol. amygdal. express	5.0

M. Ft. ung. Sig.—Toilet unguent.

348.

℞. Yellow mercuric oxide, thoroughly dried	250 Gm.
Oleic acid	750 Gm.

M. Sig. — Oleate of mercury.

"Introduce the oleic acid into a capacious mortar, and gradually add to it the yellow mercuric oxide by sifting it upon the surface of the acid, and incorporate it by continuous stirring. Then set the mixture aside in a warm place, at a temperature not exceeding 40° C. (104° F.), and stir frequently, until the oxide is dissolved."

Make one-fiftieth the quantity. If heated too much the oleate becomes discolored and does not keep well.

349.

℞. Camphor liniment	100 Gm.
White wax	300 Gm.
Lard	600 Gm.

M. Sig. — Camphor cerate, U. S. P.

"Melt the white wax and lard with the aid of a gentle heat; then add the camphor liniment, and stir the mixture occasionally, until it has become cold."

Make 20 Gm.

350.

℞. Solution of lead subacetate	200 Gm.
Camphor cerate	800 Gm.

M. Sig. — Goulard's cerate, U. S. P.

"Mix them thoroughly. This cerate should be freshly prepared when wanted."

Make 25 Gm.

351.

℞. Resin	350 Gm.
Yellow wax	150 Gm.
Lard	500 Gm.

M. Sig. — Basilicon ointment, U. S. P.

"Melt them together at a moderate heat, strain the mixture through muslin and allow to cool without stirring."

Make one ounce.

352.

℞. Resin, in fine powder	140 Gm.
Lead plaster	800 Gm.
Yellow wax	60 Gm.

M. Sig. — Resin plaster, U. S. P.

"Melt the lead plaster and yellow wax together with a gentle heat; then add the resin, and, when it is melted, mix the mass thoroughly."

Make one ounce.

353.

℞. Soap, dried and in coarse powder	100 Gm.
Lead plaster	900 Gm.
Water, a sufficient quantity.	

M. Sig.—Soap Plaster, U. S. P.

"Rub the soap with enough water to reduce it to a semi-liquid state; then mix it with the lead plaster, previously melted, and evaporate to the proper consistence."

Make one-twentieth the quantity.

354.

℞. Emplastri plumbi	2″ x 3″

355.

℞. Emplastri cantharidis pro auribus	No. ij

Sig.—To go behind the ears.

356.

℞. Camphoræ	2
Ceræ albæ	1
Adipis	6

M. Ft. ung. Sig.—Camphor ointment, N. F.

Melt the white wax, add the lard, then the camphor, and continue the heat until the camphor is dissolved, then stir until cold.

357.

℞. Bismuthi subnitratis	ʒ ij
Zinci oxidi	ʒ j
Acidi salicylici	gr. x
Amyli	ʒ ij
Adipis	ʒ vj

M. Ft. ung. Sig. — Apply 2 or 3 times daily.

This is best made in a warm mortar with melted lard. A very stiff ointment results.

CHAPTER XIII.

MISCELLANEOUS EXTERNAL PREPARATIONS.

Poultice or Cataplasm (Lat. *Cataplasma, tis*). — A soft, mushy preparation, composed usually of some mealy substance capable of absorbing a large amount of liquid, made into a paste with hot liquids, and spread thickly upon cloths, then applied to the body while hot.

Fomentation (Lat. *Fomentum-i*). — A poultice composed of herbs or other non-absorptive material and hot liquids or lotions, absorbed in woolen cloths and applied hot.

Spongio-piline. — A thick cloth containing small pieces of sponge on one side and rubber or other water-proof material on the other, intended for the absorption and application to the skin of hot liquids.

Plaster Mull. — A thin cloth covered on one side with rubber or gutta-percha, or attached to gutta-percha tissue, upon which a medical agent in liquid form is spread or painted. These are used in the same way as plasters, absorption being facilitated by the impervious nature of the cloth.

Plasmas (Lat. *Plasma, atis*). — Non-fatty, unctuous preparations, designed as substitutes for ointments, cerates, etc., in the local application of remedies, or as a substitute for poultices.

Caustics or Escharotics (Lat. *Escharotica, æ*). — Substances used for the destruction of tissues by the caustic action of chemicals or by heat. They are used in the form of

Pastes (Lat. *Pasta, æ*). — Semi-solid masses, composed of starch, flour or other diluent, with the chemical agent and sufficient water, alcohol or glycerin to wet the mixture thoroughly.

Paints (Lat. *Litus, oris,* or *pigmenta, æ*). — Fluid or soft preparations applied with a camel's-hair brush. They are used in the forms of

(1) **Collodion** (Lat. *Collodium, i*) — Solution of pyroxylin in ether-alcohol, with or without medicinal agents and which leaves a hard film on drying.

(2) **Drying Liniments** (Lat. *Linimenta Exsiccantia, æ*). — Mucilages of gums or albumin, medicated, which leave a thicker but less tenacious film than the collodions on drying.

(3) **Glycero-gelatins** (Lat. *Gelatina, æ*). Medicated globules of gelatin with glycerin, similar to gelatin suppositories, which are melted at the time of use and applied with a brush.

Pencils or Crayons. — These are of two kinds — the **hard soluble pencils** (Lat. *Stilus dissolubilis* or *Stilus dilubilis*) composed of small sticks of moulded chemicals, used mostly as caustics or astringents, or of medicinal agents mixed with a stiff mucilage of tragacanth, starch or other gums, and formed into sticks which are then dried, and **Salve Pencils** (Lat. *Stilus unguentes*) mixtures of waxes, oils, resins, etc., with medicinal agents (astringent, antiseptic, cooling, etc.) and moulded into stick form. Camphor ice is a type of these.

Moxas. — Small cones of combustible matter, with an oxidizing agent, which glow, but do not inflame when ignited, and give out an intense heat; intended for cauterization by direct heat.

POULTICES are seldom prepared by the apothecary, but he is frequently called upon for directions for preparing and applying them. They owe their virtues in part to the moist heat which they contain, and therefore need to be renewed every few minutes, except in the case of mustard poultice, which acts through the volatile oil formed therein. The other poultices may be used again and again, simply requiring to be re-heated each time before applying. They should be applied as hot as can be borne, and covered with thick cloths while upon the person, to prevent loss of heat. A good test of their temperature is their application to the back of the hand, which should be borne easily. The preparation of linseed poultice may be taken as a type of all these.

This is made by quickly stirring about 10 fluidounces of boiling water into 4 ounces of linseed meal, contained in a warm dish or pan. The mush thus made is then spread thickly upon a piece of cotton or linen cloth, and immediately applied to the skin. If the skin is first greased slightly with a little lard or oil, sticking will be prevented. When the poultice has become only lukewarm, another should be in readiness to take its place, and the treatment continued as long as may be necessary.

Bread-and-milk poultice is prepared by heating together sweet milk and bread deprived of its crust, and incorporating a little lard.

Mustard poultices differ from most of this class in preparation and in action. Pure mustard is used only in exceptional cases, when a prompt and strong action is desired. This is quite likely to blister the skin.

For ordinary cases the mustard is diluted with about an equal weight of flour, corn meal, flaxseed meal or other emollient, or with about half its volume of sodium bicarbonate. In the latter case a vigorous rubefacient action is produced, but the poultice seldom blisters. The mustard should be wet with lukewarm water, never with boiling water, since the action of the mustard is due to a volatile oil generated by the moisture, and this will not be formed if too much heat is applied.

The dry mustard may be mixed with its diluent and moistened, or two mixtures may be made, one with the lukewarm and one with hot water, then these two stirred together.

In applying these, a thin cloth is usually placed between the moist mass and the skin, and staining thereby prevented.

The poultice is allowed to remain upon the skin from ten minutes to an hour or more, according to the demands of the case. The action is usually at its height in fifteen to twenty minutes, but a redness is produced in a shorter time. Upon very tender skins, or in cases of a weak system, a short action may be better than a protracted one.

Mustard poultices or plasters are also called *sinapisms.*

PLASMAS AND PASTES.

Non-fatty bases, consisting of glycerin and water, thickened into a jelly-like mass with starch, gelatin or other agents, or pastes composed of starch or inert insoluble matters, with glycerin, water, soap or fats, have been recommended as substitutes for the fatty ointment bases.

They are about the consistence of ointments and have the advantage of greater cleanliness, easy removal from the skin and miscibility with aqueous fluids. They are excellent solvents in themselves for many bodies. They do not become rancid, but they mould quickly, and unless some preservative agent is present, putrefaction soon begins. They become hard on exposure to the air, by evaporation.

A large proportion of glycerin prevents such changes; when this is absent some of the common antiseptic agents must be used.

Plasmas or jellies made from starch or gum, do not melt like ointments when applied to the skin, and consequently medicinal matter is not as easily absorbed from them. Their chief use is as toilet preparations, or for superficial skin diseases, in which they serve an excellent purpose as cleansing, softening and cooling agents.

They are frequently perfumed, and when not designed for specific diseases are often sold under the name of "glycerin jellies," "emollient creams," etc.

Considered as toilet preparations, there are two classes of these in use; the true plasmas, opaque bodies, of which glycerite of starch and glycerite of tragacanth are types, and the transparent jellies, made from gelatin, agar-agar, etc.

The latter soften with heat or partially melt upon the skin, and are absorbed more readily. They should be made as thin and soft as possible without being fluid, and dispensed in collapsible tubes.

Glycerin jellies should contain at least one-fourth of their weight of water, since strong glycerin irritates the skin by abstracting water from it.

The gelatinizing agents in common use are:

Starch forms a jelly which is opaque when thick or translucent when thin.

Potato starch is most easily formed into a jelly, and is more translucent than most varieties.

The starch is first triturated with a little cold water to form a uniform mixture, then this is poured into boiling water, and the mixture boiled until the starch granules are fully swollen, usually about five minutes. If the starch be added directly to the boiling water it coheres into lumps which are not easily broken up, even on prolonged boiling.

The official glycerite of starch, which contains ten per cent. of corn starch, is a pretty firm jelly. Particular care is needed in making this lest the mixture become overheated and the glycerin decomposed, thereby rendering it irritating.

Tragacanth and Salep. — These are types of the gum-starches. They do not make transparent jellies, but resemble those made with starch.

Tragacanth makes a jelly in the proportion of five or six parts to one hundred, while only two to three parts of salep to one hundred are required. The process of the official mucilage of tragacanth is the best method of preparing a jelly with this.

Salep is first soaked in cold water, then this mixture is added to boiling water, and the boiling continued for a short time.

The National Dispensatory gives the following method of making salep jelly:

"Rub sixty grains of powdered salep with water in a mortar until it has swollen to four times its original bulk, then add gradually, and with stirring, a pint of boiling water, and boil down to eight ounces."

Chondrus and Cetraria. — These make very thick mucilages which are gelatinous when cold. Ten parts of the former or fifteen of the latter are required to make one hundred parts of stiff jelly. The moss is placed in a double amount of cold water and boiled half an hour, or until reduced to the required bulk. Much care is needed to prevent burning when the magma is thick, the least trace of which will make the jelly dark-colored.

When clear succulent pieces of moss are selected, a grayish-white translucent jelly is obtained. After boiling the mass is strained through cheese-cloth with pressure.

The mass is so thick that filtering is impossible, and a clear jelly cannot be obtained except by filtering a thin solution and then evaporating.

Agar-agar is the most powerful gelatinizing agent. It is prepared from several species of algæ growing in tropical waters.

The Japanese agar-agar, known also as Japanese isinglass, which is used in operations of the bacteriologist, is one of the best forms. It comes usually in strips about as thick as a straw, and is almost completely soluble in water.

One part of this makes a jelly with two hundred parts of water. It should be boiled about six hours, and filtered while hot. It filters readily when liquefied, but solidifies at 40° C., and in handling large quantities a hot filtration apparatus is needed.

It forms a very clear, firm jelly, and keeps fairly well if ten per cent. of glycerin be added. It is not as satisfactory as gelatin or chondrus, because it has a tendency to become watery or even to liquefy on standing, when it is made soft.

Gelatin comes next in power, requiring two to four parts for one hundred parts of jelly.

French "silver" or "gold-label" gelatin is best for pharmaceutical use. It dissolves easily in warm water, and usually gives a clear jelly by straining through cheese-cloth. It can be made to dissolve in glycerin by first softening with water, then heating with glycerin until dissolved and the water has passed off. The jellies containing water are apt to liquefy if stirred very much.

The solution of gelatin should be allowed to stand in a cool place to solidify, and, if not disturbed by stirring, it will keep growing firmer for a number of hours.

Isinglass resembles gelatin very closely; four parts of it make one hundred parts of clear tremulous jelly. It consists chiefly of a very pure gelatin, and is dissolved in the same manner. It is not easy, however, to obtain it of good quality.

By using larger proportions of any of these agents, stiff and rubber-like jellies may be prepared, suitable for making bougies, pencils, etc. Most of the jellies are hygroscopic, and should be preserved and dispensed in tight containers.

If made with agar-agar or gelatin, they should be clear and free from lumps.

They are easily molded, when desired, and do not stick to the molds. In all cases they should be allowed to set half an hour or longer in a cool place before dispensing.

In some cases they are used as paints, being melted and applied with a brush while hot. Thus used, they form a film upon the skin, which holds and protects the medicinal action, operating in the same manner as collodions.

Pastes are used frequently by dermatologists in preference to ointments for superficial skin diseases. They are usually pretty stiff in consistency and frequently contain a large proportion of inert powders, as starch, kaolin, talcum, or chalk to produce the stiffness. The moistening agent may be glycerin, soft soap or petrolatum. In the kaolin paste, which is employed hot and as a substitute for a poultice, the glycerin, by its absorption of water, acts as a drawing agent.

The medicinal agents employed in this form are mostly astringents, antiseptics and emollients.

Escharotic pastes were formerly used for caustic purposes, but have been superseded by the surgeon's knife, a desirable substitute in all cases when the patient will admit of it.

The preparation of pastes offers no special difficulties. The active agent is mixed with the diluent in the proportion desired, and the resulting mixture made into a soft paste by the addition of the moistening agent.

With very deliquescent substances like chloride of zinc, water must be used sparingly to avoid dissolving all of the salt and developing its causticity too strongly. The action of pastes is intended to be slow and gradual, and the salt should be in a condition of partial solution, except when the strongest action is desired. Escharotic pastes may be very painful, and are sometimes mixed or moistened with anodynes to mitigate the pain. Alcohol and glycerin are also used as moistening agents for very soluble substances, while starch, calcium phosphate, plaster-of-paris and other inert substances may be used as diluents. These pastes are applied directly to the skin, or to the skin denuded of its cuticle by a blister, or by the application of another caustic.

Caustics which are deliquescent have a tendency to spread, and this action on the surrounding tissues may be prevented by a dressing of simple cerate ointment. This prevents the spreading of the caustic over the surface of the skin by capillary attraction.

CRAYONS OR PENCILS.

Crayons or pencils are small pencil-shaped rods, usually measuring one to four inches in length, and one-fourth to three-eighths of an inch in diameter. They are intended for application to very small areas of surface, and are applied, after wetting the point or end, in the same manner as crayons. They need no dressings, and are largely used for the removal of small excrescences, or the treatment of very small areas.

They may consist entirely of the active agent, or of the agent in a diluted form.

They are prepared by fusion, or by combination with a suitable base.

Easily fusible salts, as silver nitrate and zinc chloride, or salts which melt easily in their water of crystallization, as zinc and copper sulphates, alum, etc., are simply melted and poured into suitable molds. The molds used for preparing urethral suppositories may be used for this purpose.

The pencils of lunar caustic and diluted nitrate of silver are familiar examples of these. The molds should be warm to prevent too sudden congealing, and the liquid should be near its congealing point to obtain a smooth surface. The molds should not be greased, but should be perfectly clean.

Salts that are melted in their water of crystallization must not be heated too long, lest a portion of the water be driven off. It is best to weigh these before melting, and again just before molding, making up any loss in the second weighing by the addition of boiling water. A porcelain or metallic capsule or crucible is the best form of vessel in which to fuse the salts.

Silver nitrate pencils contain a small proportion (about five per cent.) of chloride of silver (U.S.P.) or of potassium nitrate (Ph. Br.) to toughen them. If made from the pure salt, they are brittle and crystalline. A slight excess of nitric acid is sometimes also added to the melted salt to prevent discoloration.

If the melted salt is too hot when poured into the molds, they are likely to brittle and uneven as well as discolored.

Zinc chloride is seldom made into pencils, owing to its extreme deliquescence.

Copper sulphate may be molded pure, or mixed with half its weight of powdered alum, and the mixture fused and molded.

Pencils of pure copper sulphate may also be formed out of selected crystals of the salt by turning in a lathe, or by filing.

For non-fusible bodies, when the active agent is desired only in a diluted condition, and when other medicaments than caustics are desired in the pencil form, a base or form must be used.

Gelatin makes a flexible pencil which is not easily broken, and which preserves the active agent in good condition. The jelly used for making these should be pretty stiff, containing ten to fifteen per cent. of gelatin with some glycerin. The medicinal matter may be incorporated with the fluid before molding, when the pencil will contain a definite proportion of it, or a pencil-form may be made of jelly, which is coated with the active agent by rolling therein. In the latter case the pencil is moistened on the surface before rolling, unless the mass contains a considerable proportion of glycerin.

Gums, with starch or flour, make a stiff and hard pencil. They are moistened with a mixture of glycerin and water, the glycerin being necessary to prevent them from becoming so hard as to scratch the skin, and also to preserve them in a condition to yield up their medicinal matter readily. The gums employed are usually tragacanth and dextrin, the tragacanth furnishing a good body, and the dextrin supplying the additional adhesive qualities needed. A general vehicle for these, often employed, is composed of equal weights of white dextrin, glycerin and water.

Another good general mixture is tragacanth, 5 parts; dextrin, 30 parts; powdered sugar, 20 parts, and starch, 10 to 35 parts. The starch is used as a filler, and varied in quantity according to the proportion of active agent desired. Thus, for a pencil to contain ten per cent. of medicinal agent, 10 parts are added to the above quantities, while for forty per cent. of medicinal agent only 5 parts of starch, or, better, 10 parts of starch and 15 parts of sugar can be used. The powdered ingredients are mixed intimately, and made into a stiff mass by the addition of a sufficient quantity of glycerin-water. The mass is then rolled into the desired form and dried. Unless otherwise specified the pencil may be made two and one-half inches in length and one-quarter inch in diameter. They should taper to a point at one end. They should be wrapped in tin-foil or paraffine paper, the label being affixed to one end. As with the gelatin pencils, the points or the surface to which they are applied, must be wetted before being applied.

Salve pencils are made of wax and hard fats, and should be firm enough to resist breaking, and yet soft enough to yield a film of their substance to the skin when rubbed upon it. They are larger than the soluble pencils, being one-half to three-quarters of an inch in diameter, and about two inches in length. They are made in the same manner as suppositories, by either hot or cold process, and should contain only sweet and non-irritating fats. The same rules as those given for suppositories apply to these, except as regards melting points, which may or may not be a consideration in pencils.

Pencils used for toilet and theatrical purposes are generally desired of high fusing points.

MEDICATED DRESSINGS.

Medicated Gauzes and Cottons are usually prepared by plaster manufacturers or special dealers, though their preparation is quite within the range of retail pharmacists.

They are generally understood to contain a certain percentage or quantity of medicinal agent in the finished gauze or cotton.

Besides this they may contain a small quantity of glycerin, or of oil and resin, to preserve a degree of softness and promote the activity of the medicinal agent.

To prepare them the compounds are dissolved in ether, alcohol or other volatile solvent; the glycerin, or rosin and a fixed oil, is added to this, then the mixture is thoroughly diffused through the gauze or cotton, then wrung out and dried. They must be dried quickly, but without heat. If allowed to remain in folds, or if not dried promptly, they are apt to become streaked. This can be prevented by wringing well, or by spreading out thinly, in a horizontal position, in a current of dry air.

If volatile ingredients are present, the gauze should be collected and preserved in tight containers as soon as the ether or alcohol has evaporated, or even before the last traces have disappeared. Since medicinal matter diffused in this manner is in a condition to change readily by action of air and light, or to evaporate if volatile, these preparations must be preserved in tight receptacles.

Futhermore, for their use in surgical dressings, pains should be taken to secure absolute cleanliness and to exclude disease or harmful germs.

In calculating the quantities of solution and of gauze required to obtain a gauze of definite percentage strength, allowance must be made for the additional weight of glycerin or of rosin and oil in the solution, which is retained in the finished gauze. Thus the weight of the finished gauze will be the weight of the original gauze plus the total weight of the solids or non-volatile matter in the solution absorbed, and the weight of the medicinal agent must be in proportion to the total or final weight of the gauze, not simply to the gauze taken. (See note under iodoform gauze, No. 401.)

CATAPLASMS, PLASMAS, PASTES, PENCILS, MEDICATED DRESSINGS.

358.

Cataplasma Carbonis (Ph. Br.). **Charcoal Poultice.**

Powdered wood charcoal	1 ounce
Crumb of bread	2 ounces
Linseed meal	1½ ounces
Boiling water	10 fluidounces

"Macerate the bread in the water for ten minutes near the fire, then mix; add the linseed meal gradually, stirring the ingredients that a soft poultice may be formed. Mix with this half the charcoal, and sprinkle the remainder upon the surface of the poultice."

359.

Cataplasma Fermenti (Ph. Br.). **Yeast Poultice.**

Beer yeast	6 fluidounces
Wheaten flour	14 fluidounces
Water heated to 100° F.	6 fluidounces

"Mix the yeast with the water, stir in the flour, and place near the fire till it rises."

360.

Cataplasma Sinapis (Ph. Br.). **Mustard Poultice.**

Powdered mustard	2½ fluidounces
Lukewarm water	2 to 3 fluidounces

Mix.

Linseed meal	2½ fluidounces
Boiling water	6 to 8 fluidounces

Mix.

Stir the two poultices together.

361.

Cataplasma Sodæ Chlorinatæ (Ph. Br.). **Chlorine Poultice.**

Solution chlorinated soda	2 fluidounces
Linseed meal	4 fluidounces
Boiling water	8 fluidounces

Mix the linseed meal and boiling water, and add the soda solution.

362.

Onion Poultice.

Onions, chopped fine	6 to 10
Rye meal	An equal quantity
Vinegar	Enough to make a paste

Mix the three and heat in a suitable pan, allowing the mixture to simmer about ten minutes, stirring frequently; apply hot, and renew frequently.

363.

Tragacanth	6 Gm.
Glycerin	18 Gm.
Water, a sufficient quantity to make	100 Gm.

M. Sig. — Mucilage of tragacanth, U. S. P.

"Mix the glycerin with seventy-five (75) cubic centimeters of water in a tared vessel, heat the mixture to boiling, add the tragacanth, and let it macerate during twenty-four hours, stirring occasionally. Then add enough water to make the mixture weigh one hundred (100) grammes, beat it so as to make it of uniform consistence, and strain it forcibly through muslin."

Make 20 Gm.

364.

℞.	Ichthyoli	20
	Amyli	20
	Albuminis ovi, liquidi	0.75
	Aquæ destillatæ	60

M. Sig. — Ichthyol drying-liniment.

Boil the starch in the water until smooth, and incorporate the other ingredients.

365.

℞.	Pulv. tragacanthæ	1
	Sodii boratis	1
	Glycerini	36
	Aquæ rosæ	5

M. s. a. Sig.—Glycerin Ointment.

Mix the gum thoroughly with the glycerin, heat and add the borax dissolved in the rose water.

366.

Starch	10 Gm.
Water	10 C.c.
Glycerin	80 Gm.

M. Sig.—Glycerite of Starch, U. S. P.

"To the starch, contained in a porcelain capsule, add the water and glycerin, and stir until a homogeneous mixture is produced. Then apply a heat gradually raised to 140° C. (284° F.), and not exceeding 144° C. (291° F.), stirring constantly, until a translucent jelly is formed. Transfer the product to suitable vessels, provided with well-fitting covers."

Make one fifth the quantity.

367.

℞.	Amyli	ʒ ij
	Aquæ	℥ x

M. Sig.—Mucilage of Starch, B. P.

Triturate the starch with the water, gradually added, then boil for a few minutes, constantly stirring.

368.

℞.	Calomelanos	1.0
	Acidi tannici	1.0
	Glyceriti amyli	30.0

M. Sig.—Calomel and tannin plasma.

369.

℞.	Zinci oxidi	10
	Acidi salicylici	0.2
	Glyceriti amyli	10

M. Sig.—Apply as needed.

370.

℞.	Sulphuris	10.0
	Tinct. benzoini	10.0
	Mucilaginis amyli	80.0

M. Sig.—For external use.

371.

℞.	Zinci oxidi	24
	Calcii carb. præcip.	24
	Linimenti calcis	50

M. Sig.—Unna's Soft Zinc Paste.

Mix the powders and gradually incorporate the liniment.

372.

℞. Acid salicylici	2
Zinci oxidi,	
Amyli	āā 24
Petrolati albi	50

M. Sig.—Lassar's Zinc Paste.

373.

℞. Naphtholi	10
Sulphuris præcip.	50
Petrolati,	
Saponis mollis	āā 20

M. Sig.—Lassar's Naphthol Paste.

374.

℞. Kaolini	50
Glyceriti boroglycerini	10
Methyli salicylatis	0.5
Thymoli	0.5
Glycerini	ad. 100

375.

℞. Gelatini	2.0
Glycerini	50.0
Aquæ	35.0

M.

Add the gelatin to the water and heat on a water-bath until completely liquefied, then add the glycerin, mix well and pour into bottles to cool and solidify, or put when cold into collapsible tubes.

376.

℞. Gelatini	10
Albuminis ovi	20
Acidi salicylici	1
Aquæ rosæ	225
Glycerini.	250

M. Sig.—"Glycerin Jelly."

Dissolve the gelatin in the rose-water by aid of a very gentle heat. Let cool and before it jellifies stir in the albumen. Dissolve the salicylic acid in the glycerin, and after again warming the gelatin solution add it to the latter, stirring constantly. When well mixed strain into gallipots or wide-mouthed bottles and allow it to gelatinize.

(Used for chapped lips and hands, blisters, etc.)

377.

℞. Gelatini.	4
Zinci oxidi	3
Glycerini	5
Aquæ	9

M. s. a. Sig.—"Unna's Glycerin Jelly."

Melt the gelatin in the water by aid of heat, add the glycerin and *sift* in the zinc oxide; strain through cheese-cloth and stir until it begins to thicken.

(When required for use a portion is melted and applied with a brush.)

378.

℞. Glycerini	24
Amyli	3
Tinct. arnicæ	4
Aquæ.	6

M. Sig.—Arnica jelly.

Heat the starch, glycerin and water until a transparent jelly is obtained, and when cold incorporate the arnica.

379.

℞.	Adipis lanæ hydros	10
	Tinct. quillajæ	20
	Olei amygdal. exp	10
	Gelatini	4
	Aquæ Fervent	q. s.

M. Ft. gelatinum. Sig. — "Lanolin paste."

Dissolve the gelatin in 75 parts of hot water and strain.

Emulsify the lanolin and oil with the tincture of quillajæ in a warm mortar, add the warm gelatin solution and stir until the mixture thickens.

Set aside to cool.

380.

℞.	Gelatin chondri,	
	Glycerin	āā 25

M.

Prepare the chondrus jelly by boiling 5 Gm. of the moss with 200 C.c. of water down to 25 C.c.; when strained, add the glycerin while warm, and place in wide-mouthed bottles, or jars, to stiffen.

381.

℞.	Cydonii contusi	4.0
	Aquæ bullientis	400.0
	Sodii boratis	4.0
	Glycerini	60.0
	Spiritus camphoræ	30.0
	Ol. amygdalæ amaræ	0.60

M. Sig. — "Camphor cream."

Macerate the quince seed in the water for 12 hours, strain and add the glycerin and borax. Gradually add the spirit, in which the oil has been dissolved, and mix thoroughly.

382.

℞.	Saponis	12
	Benzini	38
	Aquæ ammon. fort	38
	Aquæ	q. s

M. Sig. — "Benzine jelly."

Shave the soap very fine, place in 6-inch capsule, cover with 45 C.c. water, and heat on a water-bath until the soap is soft and jelly-like. Add water to make 45 Gm. of mixture, mix well and squeeze through cheese-cloth into 4-ounce, wide-mouthed bottle. Add the benzine, shake together, then gradually add the stronger water of ammonia, constantly shaking.

383.

℞.	Benzini	℥ j
	Tinct. quillajæ	℥ ss

M. Sig. — "Benzine jelly."

384.

℞.	Benzini	℥ j
	Tinct. quillajæ	ʒ ij
	Aquæ ammoniæ fortioris	ʒ ij

M. Sig. — Benzine jelly.

385.

℞.	Iodoformi	10
	Gelatini	5
	Glycerini	20
	Aquæ destillatæ	65

M. Sig. — Unna's Iodoform gelatin.

Dissolve the gelatin in the water by heat. Triturate the iodoform with the glycerin, add to the gelatin solution, and pour into chilled molds.

386.

℞.	Glycero-gelatini zinci oxidi, 10 per cent.	100

Dissolve 15 Gm. of gelatin in 35 parts of water and 24 parts of glycerin, by heat. Levigate 10 Gm. of zinc oxide with 15 Gm. of glycerin, add to the gelatin solution and pour into chilled molds.

387.

℞. Balsami peruviani,	
Iodoformi	āā ʒ ij
Glycerini	ʒ xiv

M. Ft. unguent.

A solid paste results on mixing. A peculiar mixture.

388.

℞. Zinci chloridi	20
Amyli	20
Zinci oxidi	5

M. Ft. escharotica. Sig. — Chloride of zinc paste.

Mass with water, and roll rapidly into cones, which are then rolled in talc.

389.

℞. Zinci oxidi	20.0
Cretæ præparatæ	10.0
Liq. plumbi subacet	10.0
Olei lini	10.0

M. Sig. — Zinc-lead paste.

Shake together the lead water and oil, and stir into this mixture the powders, taking care to thoroughly mix.

390.

℞. Acidi sulphurici,	
Carbonis ligni	āā *p. e.* q. s.

M. Ft. pasta. Sig. — Acid cautery paste.

391.

℞. Acidi arsenosi	gr. ij
Morphinæ sulphatis	gr. j
Creosoti	q. s.

M. Ft. pasta.

392.

℞. Farinæ tritici	30
Phosphori	2.5
Aquæ	15
Syr. fusci	30
Barii carbonat	15
Adipis	15

M. s. a. Sig. — *Rat Paste.*

Make a dough with the flour and water, and incorporate the lard.

Place the molasses in a wide-mouth bottle, add the phosphorus and heat upon a water-bath until the latter is melted, stir well to suspend the phosphorus, and then add to the dough and incorporate quickly. Finally stir in the barium carbonate and bottle.

(CAUTION. — The mass is liable to take fire while incorporating the phosphorus, which should be done in an open space, the hands being protected by wrapping in wet cloths.)

393.

℞. Acidi salicylici	4.0
Ceræ albæ	5.0
Adipis lanæ hydros	11.0

M. Ft. Stilis. Sig. — Salicylic acid pencils.

394.

℞.	Iodoformi	2
	Zinc oxidi	1
	Olei theobromatis	6
	Ceræ flavæ	5
	Tragacanthæ	4

M. Ft. bouginariæ, vi. no. Sig.—Iodoform crayons.

395.

℞.	Iodoformi	ʒ j
	Amyli	ʒ iij
	Tragacanthæ	ʒ j
	Dextrini	ʒ j
	Sacchari	℥ ss
	Glycerini,	
	Aquæ	āā q. s.

M. Fac. stilos. xiij no. Sig. — Iodoform pencils.

396.

℞.	Ichthyoli	4
	Tragacanth. pulv	1
	Amyli	6
	Dextrini	7
	Sacchari pulv	2

M. Ft. stili. Sig.—"Ichthyol pencils."

397.

℞.	Acidi carbolici	2
	Resinæ	4
	Ceræ flavæ	8
	Olei olivæ	6

M. Ft. stili. Sig. — "Carbolic acid pencils."

398.

℞.	Iodoformi	8
	Resinæ	1
	Ceræ flavæ	6
	Olei olivæ	5

M. Ft. stili. Sig. — Forty per cent. iodoform pencils.

399.

℞.	Carbonis ligni	30.0
	Potassii nitratis.	4.0
	Ferri alcoholisati.	5.0
	Benzoini	1.0
	Mucilag. acaciæ	q. s.

M. Ft. styli. Sig.—Moxas, or cauterizing pencils. To be ignited and applied.

(Ferrum alcoholisatum—"alcoholized," —*i. e.*, powdered iron.)

400.

Carbasus Carbolata, N. F. (Carbolized Gauze.)

Resin, in coarse powder	40 parts
Castor oil	5 parts
Carbolic acid	10 parts
Alcohol	225 parts
Gauze muslin, a sufficient quantity.	

Dissolve the resin, castor oil and carbolic acid in the alcohol. Then immerse in the mixture loosely folded pieces of gauze-muslin, allow them to become thoroughly saturated, then take them out and press out the excess of liquid until the weight of the impregnated gauze amounts to 170 parts for each 100 parts of original fabric. Spread out the pieces horizontally, and as soon as the alcohol has nearly all evaporated, fold and wrap the pieces in paraffin paper and preserve them in air-tight receptacles. The impregnated gauze, when dry, contains about 2.5 per cent. of carbolic acid.

401.

Carbasus Iodoformata, N. F. (Iodoform Gauze.)

Iodoform	10 parts
Ether	40 parts
Alcohol	40 parts
Tincture of benzoin	5 parts
Glycerin	5 parts
Gauze muslin, a sufficient quantity.	

Dissolve the iodoform in the ether and add the alcohol, tincture of benzoin and glycerin. Immerse in a weighed quantity of this solution, contained in a suitable vessel, the exact amount of gauze required to absorb the whole of it, to produce a product of a prescribed percentage of iodoform, work it about with a pestle so as to impregnate it uniformly; then take it out, hang it up in a horizontal position to dry, and in a dark place. Lastly wrap it in paraffin paper and preserve it in air-tight receptacles.

NOTE. — To calculate the amount of muslin and of iodoform solution required to obtain a product approximately of any required percentage of iodoform, let x denote this required percentage. Then take of the above iodoform solution ten times this quantity (or $10x$). Also multiply the required percentage (x) by three, divide the neutral product by two and subtract the quotient from 100 $\left(100 - \frac{3x}{2}\right)$. The remainder represents the number of parts by weight of gauze-muslin to be used.

402.

Gossypium Stypticum, N. F. (Styptic Cotton.)

Purified cotton,
Solution of chloride of iron,
Glycerin,
Water, each, sufficient quantity.

Mix the liquids in the proportion of 5 parts of the iron solution, 1 part of glycerin and 4 parts of water, in such quantities that the cotton shall be completely immersed in the liquid when gently pressed. Allow the cotton to remain in the liquid one hour, then remove it, press it until it has been brought to *twice* its original weight, spread it out in thin layers, in a warm place, protected from dust and light, and when it is sufficiently dry transfer it to well-closed receptacles.

CHAPTER XIV.

STERILIZATION AND DISINFECTION.

Modern methods of medical and surgical treatment demand that the pharmacist shall appreciate the value of antiseptic agents and preparations in the treatment of diseases. The science of bacteriology has changed the methods of treatment, in some instances radically, and frequently the composition of the preparation is secondary in importance to its condition and the way it was prepared. For since most diseases are now known to be caused by germs, in one form or another, the destruction of germs and their elimination have come to be regarded as matters of first importance. Hence the large use of antiseptic agents at the present time.

While the value of sterilization is universally recognized, the specific conditions which demand it will be found to vary in the judgment of physicians. Some are very particular about it at all times, while others are indifferent toward it except in special cases. From business motives, the pharmacist should be prepared to supply exactly what is wanted without thought as to whether the desire is consistent or not. A pleased physician is many times a pleased customer.

The germs which cause disease are known according to their form and characteristics, as

Bacteria, a general term applying to all those which are concerned in the disease-producing and putrefactive processes. According to their shape they are divided into

Bacilli, those having the form of a rod. Some of these have the power of motion in fluids, and are called **motile.**

Micrococci or Cocci, a globular form, appearing like small dots under a microscope. The diseases in which pus is formed are caused mostly by this class. According as the micrococci are grouped, they are known as **diplococci,** in groups of two, **tetrads,** in groups of four, **streptococci,** in chains of indefinite number, **staphylococci,** in clusters, **sarcinæ** in solid cubical masses.

Spirilla or Vibrios, rod-shaped organisms having a curved form, and appearing something like minute worms.

Only a small proportion of the known germs cause diseases, and those which do are called **pathogenic** bacteria, while those which are regarded as harmless to the human system, are termed **non-pathogenic.**

A somewhat higher order of organisms are the **fungi** and **yeasts** which are the cause of putrefaction and fermentative processes.

These are one of the lowest forms of vegetable life, and are reproduced either sexually or non-sexually by budding or fissure. They contain no chlorophyll and are dependent for their food upon dead or living organic matter obtained from the higher orders of plants or animals. They are familiar as the common **molds** or **mildews,** (of which they are a variety of species) or as yeasts.

They are the primary causes of decay or of fermentation, and in a very few instances they are the cause of disease. Familiar instances of them are the cheese-mold (*Penicillium Glaucum*) which is present everywhere, and is carried about by currents of air until it finds lodgment and a chance to develop. It is a troublesome fungus to the bacteriologist, often spoiling his cultures by contamination or by crowding out other germs. Others are the fungus of sour milk and sour bread (*Oidium Lactis*) and of vegetable putrefaction (*Aspergillus Niger*) a variety of which can grow on animal organisms and produce disease and death. The skin diseases *favus* and *ring-worm*, and the ear-disease *otomycosis* are caused by fungi. There are a number that cause disease in fish, insects and animals.

But to the pharmacist they may be troublesome as the cause of decay in moist drugs, or as the cause of fermentative or putrefactive changes in syrups, alkaloidal solutions, infusions, aqueous extracts, etc. These molds or yeasts are very difficult to exclude, since they are everywhere present. Many are too small to be filtered out by the ordinary methods of filtration, but are easily killed by heat. Others are large and can be filtered out. The number of known species of fungi is estimated at 30,000, and includes the edible mushrooms and truffles to the poisonous ergot, and the pathogenic tinea. Some are commercially valuable, as yeast, some produce useful products under favorable development, as diastase, lactic and citric acids, etc. But all are troublesome when out of place.

Besides the bacteria, some diseases are caused by **protozoa** organisms which belong to the animal kingdom. They are of irregular form, pass through a complex cycle of development, and are related to the amœba of our fresh-water ponds. Small pox, malaria, tropical dysentery, and probably other diseases are caused by them.

All these germs require favorable conditions of moisture, food, and temperature for the sustenance of life, and may be very sensitive to changes in their environment. They are extremely minute, many of them being less than one twenty-five-thousandth of an inch in diameter, so the necessary moisture and food may be found in places where the eye would see nothing. When dried, some die and some lie dormant like seeds. In fact some have a definite seed form, known as **spores,** which resist drying and destruction to a marked degree. Fortunately the most of the pathogenic bacteria do not form spores, and so are the more easily killed.

While the non-pathogenic germs are in themselves harmless in solutions or if introduced into the system, yet in their development they may form products which are harmful, or they may decompose active medicinal bodies, such as alkaloids, using them up as food. Hence it is frequently necessary to sterilize a liquid which is to be kept for some time, while a similar solution used immediately would not need to be so treated.

A body is sterilized when all germs of any sort are killed, including spores. Sterilization means the destruction of all life usually by heat. A body is **disinfected** when all germs contained in it have been killed or rendered innocuous by the use of antiseptics.

The term disinfectant is most commonly applied to the process of destroying germs which may be present in houses, ships, clothing, bales of rags, cotton, furniture, etc., which have been in contact with cases of contagious diseases, or in destroying the organisms on the hands in preparing for an operation.

Bodies which are entirely free from living germs are termed **aseptic.**

Now while complete asepsis is not necessary in all medical treatment, it is evident that all articles used in a sick-room should be free from pathogenic germs, at least.

Sterilization is required for special conditions, or for specific purposes. It is therefore the special article that the pharmacist may be called upon to sterilize, and it may be that the demand is so rare that the process seems unimportant. But it is just the special demand that counts the most when it is supplied.

Disinfection and sterilization is accomplished by heat or by chemical agents. Sunlight destroys germs, but several hours' exposure is usually necessary, and it is not depended upon as an artificial means of sterilization. Nature, more patient than we, uses it effectively.

In the use of chemical agents we are restricted to such as do not harm the substance which is sterilized, and further to those which do not interfere with the purposes of the article, or be objectionable if taken or applied themselves. Thus it would not do to use for sterilizing a medicinal preparation, a substance which is itself poisonous or irritating.

Next to the choice of an agent comes the question of the strength in which it should be employed.

Partial disinfection is often sufficient for certain treatments. When chemical agents are used in quantity just sufficient to inhibit the growth of germs without entirely destroying them, they are termed **antiseptics,** and the process **antisepsis.** In such cases it is intended that all pathogenic germs which are likely to be present shall be killed, but that non-pathogenic germs shall only be prevented from multiplying.

This may be accomplished either by the use of agents which are not powerful enough to kill all germs and their spores, but which may kill the more sensitive and reduce the vitality of the rest, or it may be accomplished by the use of powerful disinfectants used in solution too weak to destroy all the germs present. The same substance may therefore act as an antiseptic in weak solutions, and as a disinfectant in strong solutions.

The medium in which it is employed also makes a difference. For instance, distilled water, if perfectly pure, will act as a germicide by starving the bacteria, but it is never pure enough to accomplish this completely. Pond or river water, containing organic matter, will furnish food and favorable conditions for their development, and a solution of peptone or albumen is still more favorable. Thus it would take a larger proportion of any agent to sterilize a beef extract or an organic solution, than to sterilize the same quantity of distilled water. Beside organic matters, weak solutions of salt and phosphates are favorable to germ life.

The propagation of germs, under favorable conditions is extremely rapid. It is estimated that a single germ will produce fifteen to twenty-five *millions* of germs in twenty-four hours. Thus we can never count on there being only a few germs present to kill.

Combinations of disinfectants sometimes increase the power of each, and sometimes decrease it. They must be combined intelligently if at all. Different germs also differ in their vital resistance. In general, the pathogenic bacteria are more easily killed than the non-pathogenic. Heat adds to the power of the disinfectant.

Heat, whenever it does not injure the article, is a preferred means of sterilizing, particularly for pharmaceutical preparations, because it does not introduce any foreign substance. Unfortunately, heat injures many of the most active medicinal agents, and its use is thus restricted.

Dry heat is more effective than moist heat. It is, of course, applied only to dry bodies. The temperature needed is 150°–170° C., or just under that at which cotton turns brown. For most articles this temperature maintained for one hour to one hour and a half is sufficient. An ordinary stove-oven, or an oil-stove oven is all the apparatus needed.

Dry heat is the most convenient way of sterilizing bottles, ointment-jars, flasks, funnels or other containers or implements. If the bottles are stoppered with cotton while being sterilized, they will remain sterile so long as the cotton remains in place. A supply sufficient for a long time may thus be sterilized in one operation.

Spatulas, glass rods, and small articles, which will bear a sudden direct heat, may be quickly sterilized by passing through a non-luminous flame two or three times. They do not need to be held in the flame, but simply exposed for an instant to the direct heat of the flame. It is safer to pass them through the flame two or three times in succession.

Moist heat is applied to all liquid bodies, and sometimes to dry substances. It is most effectively and economically applied as moist steam, in a protected chamber, as in the Arnold or Koch sterilizers. These, in the small sizes particularly, are inexpensive apparatuses, and where the operation is frequently performed, well repay their cost. The steam-cookers made for culinary purposes can be used just as effectively but less economically. But the operation can also be performed by subjecting the body to be sterilized to the full heat of boiling water. Thus an ounce of solution may be rendered innocuous by hanging the bottle containing it, stoppered with cotton, in a dish of boiling water. The time required for complete sterilization is about 20 minutes, except in the case of certain spore-bearing bacilli which may resist several hours' boiling. Unless these are supposed to be present, 20 minutes are sufficient. The time is to be reckoned, not from the moment when the article is placed in the steam or boiling water, but from the time when they have attained the full temperature. A small body will heat quickly and need be kept in the steam but a few minutes more than the required time, but a large quantity will need to remain enough longer to allow for its initial heating.

The surest method of sterilizing is to heat the object in steam for 15 minutes on three successive days. The object of successive, intermittent heating, is to allow for the killing of the spores, and this method of fractional sterilization is only applicable to those substances which contain such a food supply as will make the spores develop. In the first heating, the active, vegetating germs are killed, but not the spores. During the succeeding twenty-four hours the spores germinate but do not have time to form new spores, and in the second heating these are killed. The third heating is to insure the completion of the process. Solutions sterilized in this way will keep indefinitely without change.

In sterilizing any fluid it is to be remembered that the bottle and the cork are also to be sterilized. Rubber stoppers are best to use, because they do not lose their elasticity during the process, as do corks. Everything is covered with germs, and it is easy to contaminate a liquid after sterilizing it. Subsequent transferring to another bottle, the insertion of a new stopper, filtering, etc., will introduce fresh organisms into a sterile solution, and undo the work already done. These things must be considered in advance, and the sterilization must be the last operation. As Dr. Rosenau says of disinfection, "germs are little things, and it is little things that count in this work." Work of this kind must be thoroughly done, or it were better not to attempt it. It is a simple operation, but it requires infinite care.

Pasteurizing is heating to 60° C. (140° F.) and is applied to bodies which would be injured by the temperature of boiling water.

It is, of course, not as efficient as boiling or steaming, but it is sufficient to kill most pathogenic germs. When repeated twice, at intervals of about twenty-four hours, it is very effective. All bodies which are injured by high heat, such as alkaloids or preparations of ergot, coca, belladonna, physostigma, etc., should be pasteurized, if sterilization is required in them.

Chemical Agents. — Certain chemicals, particularly those that act upon or unite with albumen are very active as germicides. All chemicals will destroy germs in concentrated solutions, but a chemical can be properly called a germicide only when it kills the germs in comparatively weak solutions.

The strength of the solution is important in any case. Thus a solution of mercuric chloride of the strength of 1 to 15,000 will prevent the growth of all bacteria, but a strength of 1 to 1,000 is required to kill all germs and spores. Likewise a solution of formalin of the strength of 1 to 50,000 will prevent the development of most bacteria but a strength of 1 to 100 is required to kill.

Time is also required to kill germs, and the more numerous the germs, or the weaker the solution, the longer must be the contact. None are killed instantly, and the simple dipping of an article into a disinfecting solution is not sufficient. From a few minutes to several days may be required, according to the strength of the solution, the power of the germicide and the resistance of the bacteria. Temperature is another factor in the case. All chemical solutions act more powerfully when warm, and even a rise of but ten degrees in temperature may very materially increase the power of a solution. A moderate heat will multiply the power of any chemical germicide many times beyond that of room temperature. It is therefore recommended to use chemical solutions at least moderately warm, whenever possible.

The exact antiseptic power of any chemical agent is a matter of time, temperature, and the character of the germs present. The following table by McFarland shows the proportions in which vitality is destroyed under ordinary conditions of temperature, and for general purposes may be considered sufficient for pharmaceutical preparations wherever they may be suitable.

Hydrogen peroxide,	antiseptic in	1 : 20,000
Formalin,	" "	1 : 25,000 to 1 : 5,000
Mercuric chloride,	" "	1 : 14,300
Silver nitrate,	" "	1 : 12,500
Methyl violet,	" "	1 : 5,000 (1 : 2,000,000)
Creolin,	" "	1 : 5,000
Thymol,	" "	1 : 1,340
Salicylic acid,	" "	1 : 1,000
Benzoic acid,	" "	1 : 900
Zinc chloride,	" "	1 : 525
Potassium permanganate,	" "	1 : 285 (not prompt in action)
Boric acid,	" "	1 : 143
Chloral,	" "	1 : 107

Ferrous sulphate,	antiseptic in	1 : 90
Creosote,	" "	1 : 20
Carbolic acid,	" "	1 : 20 to 1 : 50
Alcohol,	" "	1 : 10
Eucalyptol,	" "	1 : 5

The articles which the pharmacist may be called upon to sterilize are injections, gargles, collyrii, infusions, and decoctions, ointments, dusting powders, etc., and it may be drainage tubes, catgut, gauzes, or surgical instruments.

To most of these heat is applicable, bearing in mind that it must not be employed when it will injure the article.

Powders of all kinds, if not volatilized or decomposed, are best sterilized by dry heat, at a temperature of 150–170° C.

Talcum, kaolin, boric acid, calomel, zinc oxide, and most powders thus used can be sterilized in this way. It has been suggested that iodoform may be sterilized by first moistening with distilled water, then heating in a steam bath for an hour, and finally dried. But one wonders why iodoform, itself a germicide, needs to be sterilized at all.

Infusions and decoctions are sterilized in the making, but when strained they are recontaminated, unless the straining is done through sterile gauze or cotton into a sterile funnel and into a sterile bottle, and even then there is great chance of contamination from the air. Fractional sterilization, the heating for 15 minutes on three successive days, is the best method. So prepared they will keep almust indefinitely. In fact sterilization is not likely to be demanded for these except for storage purposes.

Ointments are more apt to be demanded in a sterile condition. Some dermatologists are very particular about this. The easiest method is to sterilize the vehicles and medicinal agents separately, and then make the ointments under antiseptic conditions. Lard, petrolatum, wool fat, etc., may be sterilized by heating to 150° C. for an hour. If kept in the same jar in which they were sterilized, well covered, and removed as wanted with a sterile spatula, they will remain sterile for weeks. If the active medicinal agent is in itself a germicide, as carbolic acid, iodoform, etc., it may be simply mixed with the vehicle on a sterile slab. Other substances must be treated according to their character, *i. e.*, sterilized by dry or by moist heat, or by an antiseptic agent. Frequently it will be found that the use of a sterilized vehicle, and the preparation of the ointment under aseptic conditions is all the physician desires.

So prepared an ointment is not strictly sterile, but it is free from pathogenic organisms, and that may be the chief consideration. When ointments are to be applied to a raw or abraded surface, more care is necessary than when they are applied to the unbroken skin.

If it is desired to stir a sterilized ointment while cooling, a rod or spatula should be thrust through a cover of cotton and sterilized with the ointment, then the stirring is performed without removing the cotton.

Injections, particularly hypodermic injections, are the most puzzling class of preparations to sterilize. They consist of potent remedies, in a concentrated form, and frequently they are sensitive to heat. Of the alkaloids, morphine, quinine, emetine, eucaine, strychnine and codeine, will bear the heat of steam for twenty minutes without injury. Solutions of these can be sterilized by boiling, or in the steam sterilizer. Atropine, hyoscyamine, cocaine, eserine, pilocarpine, apomorphine and ergot are easily injured by heat. Cocaine and apomorphine are particularly sensitive. The others will bear a heat of 60° C. for an hour without material injury, and it has been recommended to sterilize them fractionally by heating to 60° C. for thirty minutes on three successive days. This, however, is seldom practicable, on account of the delay. Recourse must be had to some germicidal agent, and carbolic acid (3 per cent.), salicylic acid (1 to 1,000), peroxide of hydrogen, formaldehyde (1 to 5,000), thymol (saturated solution), and even corrosive sublimate have separately been suggested.

A mixture of salicylic and boric acids has also been recommended, as more efficacious than either alone; but it sometimes precipitates the alkaloids when either acid alone would not.

Salicylic acid, formaldehyde, and corrosive sublimate may be objected to, although some physicians might prefer one of them. Carbolic acid is generally considered unobjectionable, and is effective in two and a half per cent. solution (or 12 grains to the fluidounce). An effective way of using it, for a cocaine injection, for instance, is to weigh the cocaine and put it into a clean, preferably sterile bottle. Now drop upon it about one and a half *minims* of liquefied (95 per cent.) carbolic acid, for each fluidrachm of solution, stopper the bottle, and flow the acid about on the cocaine salt and the whole interior of the bottle. If the acid does not moisten the entire surface of the glass, add an equal volume of distilled water, and flow as before. Now set the bottle aside for half an hour, and sterilize a sufficient quantity of distilled water by boiling for fifteen minutes. At the end of half an hour the carbolic acid will have sterilized the cocaine and the interior of the bottle and stopper, and the proper quantity of the sterilized water may be poured in and the solution finished by agitation. The graduate in which the water is measured should be boiled twenty minutes, before measuring the sterile water.

Hypodermic injections of most of the sensitive medicaments can be made sterile after this plan.

In some instances the process can be hastened by combining heat (50° to 60° C.) with the germicidal agent, since all germicides act more powerfully in warm or hot liquids.

Thus the preliminary operation may be as before, but after five or ten minutes' action of the carbolic acid, the water may be added at a temperature of 50 to 60° C. (not higher, and for cocaine or apomorphine, not as high as this) and this temperature maintained for 15 minutes.

New bottles sometimes give trouble in alkaloidal solutions by causing precipitation. This is due to a slight alkalinity of the glass which dissolves slowly in the water and then reacts with the alkaloid solution. To insure against this it is advisable to rinse the bottle with a hot dilute acid before using, or to acidulate the water used with a slight trace of acetic or tartaric acid. But do not make a decidedly acid solution.

It should also be remembered that new bottles and glassware are hard to sterilize because they are infected to a high degree with the spore of the hay bacillus from the straw in which they were packed for shipment.

Surgical instruments, rubber drainage tubes, etc., are best sterilized by boiling. Wrap all delicate parts and cutting edges in absorbent cotton, place in a towel and make into a compact bundle with a strip of roller bandage, then boil 20 minutes. Surgical knives and sharp cutting tools are boiled only 5 minutes because a longer boiling destroys the edge. One per cent. of sodium bicarbonate should be added to the water in which these are sterilized to prevent rusting.

The towel and cotton must not be removed until the instruments are used, since they will become reinfected and unsafe to use for an operation if touched or exposed to the air and dust. If the package is to be sent out, wrap it in paraffined paper after draining, and let the surgeon or nurse remove the towel.

Gauzes and dressings are best sterilized in steam, to avoid the possibility of charring and weakening that may occur in a high dry heat. If sterilized by dry heat, the temperature must be watched carefully.

Catgut. — According to Dr. Chas. Rice, the best smooth, musical strings may be selected. The best are the violin D, A and E and the first and second banjo strings. These are coated with oil, which prevents their sterilization by alcoholic or aqueous solutions unless the oil is first removed. Three methods are suggested:

1. Simple maceration for at least 48 hours in chloroform saturated with biniodide of mercury. The strings are left in the solution, and taken out when wanted.

2. Boil the strings in enough strong alcohol to cover it, for one hour. The boiling should be performed in a flask provided with a reflex condenser. Then transfer to and keep in chloroform containing biniodide of mercury.

3. Macerate for a few hours in oil of juniper, then treat as in 2.

The second method is more certain than the first, and the third produces a better appearing catgut.

Catgut may also be sterilized by dry heat, provided it is wrapped in paraffined paper and the temperature be raised gradually. A sudden heat makes the gut brittle. Prof. Tscherning's method is as follows: The catgut is placed between sheets of parchment paper in the sterilizing oven and heated for one hour to 60° C., then the temperature is slowly raised to 100° C., which is continued for two hours, and finally to 140° C. for three hours. The gut is then wrapped in the parchment and put into envelopes of parchment paper, which are again heated to 140° C. for two hours. These are not opened until required for use.

GENERAL SUGGESTIONS.

It must be assumed that every variety of bacteria are present, and that containers, the hands, dust, water, and all substances contain them.

Sterilization should be performed in a place as free from dust and air currents as possible. Bacteria are not found in the air except when the air and the dust are stirred up.

When sterilizing a liquid in a bottle, if a water-bath is used, suspend the bottle in the water clear up to the rim, so that the entire bottle and contents will be thoroughly heated. The stopper should be loose until the liquid has become hot, then it should be pressed in firmly. Use only rubber stoppers in this way.

If corks must be used, stopper the bottle with cotton and submerge the stopper in a solution of bichloride of mercury, 1 to 500. When the liquid is sterile, take up the stopper with sterile pincers (sterilize the tips by heating in the flame), rinse the stopper well with sterile water, remove the cotton from the neck of the bottle, and quickly insert the stopper. Never sterilize corks by heat. Glass stoppers are not tight enough to be trusted.

In sterilizing fluids containing volatile substances, the bottle should be stoppered tightly as soon as it is hot. Very volatile liquids, as ether, chloroform, etc., are sterile in themselves and may be added last.

In fractional sterilization, do not open the bottle after the first heating.

If it is necessary to filter a sterile liquid, the funnel and filter-paper should be first sterilized, and the funnel kept covered during filtration. Filtration should be performed before sterilizing whenever possible.

"Germ-proof" filters are not to be trusted. It is only in very rare exceptions that they are really germ-proof. When they are, they act so slowly that their use requires more time and attention than other means.

If an accident occurs, or there is any doubt as to the sterility of a body, sterilize again and be sure of it.

Domestic disinfection is something the pharmacist is frequently consulted about. The popular idea of disinfection is quite a different thing from the scientific idea. True disinfection is a matter requiring intelligent discrimination and some degree of skill. It requires the use of materials in liberal quantities and thoroughly applied. It may be noticed that this is never applied by the householders, but by the agents of the city or town Boards of Health, under whose direction they are used. Laws regulate true disinfection in a way that takes it out of the householder's hands.

The common idea of a disinfectant is more properly a deodorizer. A substance may be a good deodorant but a feeble disinfectant. Yet deodorizing may be as valuable, as a preventer of disease, as disinfection. It is a good sanitary measure, at least, and is to be encouraged, aside from its business value.

The most effective deodorants are quicklime, chlorinated lime, sulphate of copper and formalin. These are true disinfectants, for they destroy the germs as well as neutralize the odors. The sulphates are weak as disinfectants, but good as deodorants. Formalin is good in both ways, it sterilizes thoroughly and forms odorless products, but it is expensive. For circumscribed and limited uses it is to be recommended. Quicklime, used as a whitewash, is particularly adapted to sheds, cellars, and musty places. The sulphates of iron and of copper are useful in vaults, etc., as deodorants. Chlorinated lime is useful in outhouses and various places.

Bear in mind that to be really effective **these must come in actual contact** with the surface to be deodorized or disinfected. Simply setting a dish of one of them in the middle of the room will do no good.

Another and more popular class of "disinfectants" are those which are odorous in themselves. These meet the popular idea better than those which are in themselves odorless. Creolin, sulpho-naphthol, lysol, etc., are among the most efficient of these. Like the first they accomplish good results when brought into actual contact with the body to be disinfected, but are of little value as gaseous disinfectants. The only really effective gaseous disinfectants are formaldehyde gas, generated fresh and used moist, and sulphur dioxide, also fresh and moist. When these are used, in suitable quantities nothing can remain alive in their presence.

But the creolins, etc., conduce to cleanliness and care, and that is something.

Of very little value as disinfectants are the odorous solutions composed of solutions of volatile oils, camphor, thymol, etc. These are good antiseptics when applied in strong enough solution, but when diluted they are feeble. They are popular as deodorants, and they cover other odors. The antiseptic and disinfectant action is due, as a rule, to salicylic and benzoic acids which they contain, rather than to the odorous ingredients.

When a true disinfectant is to be recommended for use in the household, formaldehyde will serve a greater variety of purposes than any other substance. It is cleanly, leaves no traces behind, and it will do as effective work as any. It should be employed in five per cent. aqueous solution, and articles to be disinfected must be thoroughly wetted with this, and kept wet for an hour. It does not injure fabrics or colors, and it can be applied to anything, even foods, but it makes leather brittle and so is objectionable for furs, book-bindings, etc. Clothing, carpets, furniture, toilet articles, pictures, instruments, fruits, roots, etc., may be thoroughly disinfected by a five per cent. solution of formaldehyde, without injury.

Other agents, as lime, chlorinated lime, carbolic acid, cresol and preparations (creolin and lysol) are cheaper, and may be used more freely. They are better adapted for outhouses, cellars, walls, and articles that can be easily washed. Lime should be used as fresh milk of lime. Chlorinated lime is best applied in a liquid form, in the proportion of six ounces to a gallon of water. Carbolic acid should be in five per cent. solution. Creolin and lysol should be in two per cent. solution. When liquids are to be disinfected, the above strengths should be doubled, so that when mixed with the liquid the strength of the disinfectant will be sufficient. For instance, a five per cent. solution of carbolic acid is needed for thorough work, but if a five per cent. solution is mixed with an equal bulk of a liquid to be disinfected, the strength of the mixture will be only two and a half per cent., which is not strong enough to do the work well.

Potassium permanganate is effective as a deodorant, when it comes in actual contact with the decaying body, but it is feeble as a disinfectant. It is more expensive and less cleanly than the other agents mentioned.

Ozonized turpentine, chlorides and other semi-secret or proprietary preparations possess no mysterious advantages, and are easily replaced. For real effectiveness, the manner in which an article is used is quite as important as the article itself.

CHAPTER XV.

HOMEOPATHIC PHARMACY.

THE word homeopathy comes from the Greek words ὅμοιος, like or similar, and πάϑος, treatment, and refers to the fundamental doctrine of this form of practice, that "like cures like." It was founded by Samuel Hahnemann, a German physician, born at Meissen, near Dresden, in Saxony, who was led by the marked effect of a large dose of cinchona to adopt the principle that a remedy given to a healthy subject should produce the symptoms of the disease it would cure. He tried many remedies, and embodied his researches in two extensive volumes. Most of the principles of homeopathic pharmacy and practice were set forth by him in the latter part of the eighteenth century, and but few changes have been made since that time.

The principal motto of the system, "*similia similibus curantur*" — like cures like — while first applied to modern medicine by Dr. Hahnemann, is yet very old, for Antiphanes says, 404 B. C.:

> "Take the hair, it is well written,
> Of the dog by which you're bitten;
> Work off one wine by his brother
> And one labor with another;
> Cook with cook, and strife with strife,
> Business with business, and wife with wife."

Homeopathic Pharmacy was first practiced in Leipsic, in 1775, and is thus comparatively new. The main principles at present advocated are: 1st. All medicines must be proved by administration to subjects in health. 2d. Remedies should be given alone, not in combination. 3d. Insoluble substances become very active medicinal agents after being reduced to an impalpable powder and thoroughly diffused through some inert substance. 4th. All medicines should be given in doses too small to produce their physiological effects.

We find no mixtures in homeopathic pharmacy. Two remedies are sometimes given alternately, but never or very seldom mixed. Remedies are also given in very small doses, since they are supposed to act upon a principle directly opposite to that adopted in allopathic practice.

The number of remedies used was originally about two hundred, but now reaches nearly a thousand. Among these are vegetable drugs, chemicals, and a large number of animal drugs, insects, etc., including musk, cantharides, burnt sponge, honey bees, cuttle-fish ink, crab, certain species of spider, several reptile poisons, star-fish, bed-bugs, cockroaches, etc.

With a few exceptions, as nux vomica, rhubarb and cinchona, the drugs are used and preparations made from them while fresh and undried, and animals and insects are captured and preserved alive until the moment of use. The nomenclature differs from that of our Pharmacopœia, being adapted largely from the German. Thus, cinchona is called "china"; quinine, "chininum"; worm seeds, "cina"; calomel, "mercurius dulcis," and mercury, "mercurius vivus," etc.

Great stress is laid upon the purity and strength of all drugs and preparations.

Thus, only distilled water is used, and that required to be obtained from tin-lined stills and condensers which are used for no other liquids. Alcohol is required to be re-distilled and kept in glass containers.

Sugar of milk is directed to be purified by recrystallizing or by precipitating with alcohol.

Homeopathic pharmacopœias have been published in England and Germany, and a National American Homeopathic Pharmacopœia has recently been issued which is authorized and published by a committee appointed for that purpose, and corresponds to the United States Pharmacopœia.

The English Pharmacopœia, and an American Pharmacopœia, published independently by Boerick & Tafel, have been mostly employed by American practitioners.

Homeopathic preparations are of three classes, (1) the tinctures, commonly called "mother tinctures," which are solutions of the soluble principles of drugs in alcohol, mixtures of alcohol and water, or, rarely, in ether, glycerin and syrup; (2) liquid attenuations made from these; and (3) powders, usually in the form of triturations.

Infusions and decoctions are used but rarely, and are made in the usual way.

Cold infusions are made by percolation, and hot infusions by maceration. All are filtered after being strained, and are made of a uniform strength—ten per cent.

The mother tinctures are also made of a uniform strength—ten per cent.—based on the *dry* drug, and great pains are taken to have the alcoholic strength the same in all cases, for the same drug. Since these are made from fresh drugs, the amount of moisture must be estimated in each lot, and allowance made for it. Thus, if tincture of aconite is to be made, using fifty per cent. of alcohol as a menstruum, the amount of moisture is first estimated, and enough strong alcohol added to make fifty per cent. alcohol with the natural juice of the root. Supposing that it contains seventy per cent. of moisture; there is first poured upon 4 troy ounces of the drug, packed in the percolator, 4.36 fluidounces (imperial measure) of ninety per cent. alcohol, the amount necessary for the conversion of the water in the drug into fifty per cent. alcohol. This is followed with menstruum of the required strength.

Most tinctures are made by percolation in glass apparatus, and those which are affected by light are stored in yellow (or amber) glass bottles. The drugs are never milled, but are prepared for percolation by bruising to a pulp in a Wedgwood mortar. Fibrous drugs are first cut in a tinned-iron mincing machine.

They are never allowed to come in contact with metals other than polished or tinned-iron.

Chemical bodies which are soluble, are sometimes used in solution, alcohol, glycerin, ether, or syrup being used as a solvent. They are required to be clear and bright in all cases, and in case of changes of character on keeping, are to be rejected.

These ten per cent. tinctures or solutions are seldom administered as made, but in nearly all cases are diluted.

The dilutions are all made in decimal proportion, and are termed *dilutions*, *attenuations*, or (rarely) *potencies*.

The tinctures or chemicals are designated by the sign θ or Φ, the word tincture or solution not being employed in prescriptions. Thus "aconitum Φ" means "mother tincture of aconite"; "acid nitricum Φ" means strong solution of nitric acid.

The dilutions are of two grades, the *decimal* and the *centesimal*. The former are denoted by numbers followed by X, and usually only the odd numbers are employed, since the even numbers will correspond to the centesimal dilutions, as 1^{X}, 3^{X}, 5^{X}, 7^{X}, etc. (2^{X} would correspond to the first centesimal dilution, 4^{X} to the second, etc.).

The centesimal dilutions are designated by simple numbers, as 1, 2, 3, 4, 5, etc.

The decimal dilutions are made by placing 10 minims of the mother tincture in a bottle and adding to it 90 minims of spirit of the same strength as the menstruum in the tincture. This is shaken with several jerks of the arm, and constitutes the first dilution, 1^{X}. The second dilution is made in the same way, using 1^{X} in place of Φ, and the mixture then constitutes the second dilution. For the third dilution, and all thereafter, strong alcohol is used. The second dilution is usually made with an alcohol intermediate in strength that of the menstruum and strong alcohol.

The centesimal dilutions are made by shaking 1 minim of mother tincture with 99 minims of menstruum, this making the first centesimal dilution, or 1.

The second is made in like manner, using 1 minim of the first and 99 minims of the spirit.

Like the decimal dilutions, all the centesimal dilutions after the second are made with strong alcohol.

Both the decimal and centesimal dilutions can be carried up to the thousandths, and the thirty-thousandth dilution has been called for, but usually the third decimal or the sixth or thirtieth centesimal dilution is called for.

The bottles in which these or the mother tinctures, solutions, etc., are kept should be cleansed, then rinsed with distilled water, and never used for any other variety. The diluting should be done in diffused, not in direct sunlight.

Triturations are mixtures of medicinal substances with sugar of milk. The medicinal substance is in most cases a chemical or insoluble body, but occasionally triturations are made by absorbing tinctures or dilutions in sugar of milk. The object of triturations is not only to diffuse and dilute the medicinal substances, but also, by long trituration, to subdivide it into the finest possible powder. Consequently a simple mixing, as by means of a sieve, will not suffice, but the two must be triturated together.

Sugar of milk is selected as a base because (1) it is devoid of medicinal action, and (2) because its crystals are very hard and of use in grinding the substance.

Wedgwood or porcelain mortars, and spatulas of bone, horn or glass, are directed to be used in making triturations.

The triturations correspond in strength to the dilutions, being of decimal or centesimal strength. The medicinal substance and the sugar of milk should both be in fine powder before mixing. If sifting is necessary, a sieve made of hair cloth is directed.

To make the first decimal trituration, the substance is placed in a clean Wedgwood mortar, and an equal weight of sugar of milk is added. These are first mixed by stirring with a glass spatula for a few moments, then they are triturated with force for six minutes, after which four minutes are occupied with scraping the powder from the sides of the mortar and pestle and mixing with the spatula, and then the trituration and scraping are repeated.

Then three parts (or three times the original weight) more of sugar of milk are added and triturated in the same way for twenty minutes, and finally five parts more of sugar of milk are poured in and triturated twenty minutes. An hour is thus occupied in making the first decimal trituration, but since most of the grinding action will necessarily be brought to bear upon the drug in making this, only half an hour is required in making each succeeding trituration. The sugar of milk is added in three portions as at first, each portion being triturated ten minutes.

The centesimal triturations are made preferably from the decimal, or at least from the first decimal trituration.

In making triturations, it is recommended that a separate or special mortar be used for each kind, since the power is extended from the remedy to the mortar. Where this cannot be done, it is required that the mortar be first cleansed thoroughly, then purified by burning alcohol in it.

If triturations are made in the drug stores, a Wedgwood mortar and pestle should be set aside for this work alone, so that those which are used for general work will not be used also for this.

Homeopathic remedies are dispensed in powders, attenuations and globules.

Rarely the tinctures are dispensed and directed to be added to a definite amount of water, of which a teaspoonful or a certain number of drops are to be taken.

The powders consist of sugar of milk, to which a given quantity of a trituration or of a dilution or tincture is added.

If the latter is used, it must be remembered that a weak alcohol will soften and partially dissolve the sugar of milk. Tincture triturations are sometimes made of which one grain corresponds to one minim of tincture.

The powders may be divided and dispensed in papers in the usual way.

The globules or pellets are little pilules of cane sugar, which are used as vehicles for the dilutions, in this providing for the administrations of fractions of a drop.

They come of various sizes, designated by numbers, the latter corresponding to the number of millimeters which ten pellets measure when placed in a row.

They are medicated by filling a vial loosely with the pellets, then pouring over them the required attenuation.

The 3x or higher dilution is commonly used. After standing a few minutes to allow of absorption, the liquid is drained off and the pellets allowed to dry.

In some sections it is customary to dispense them with a portion of the liquid in the bottle, the pellets, of course, being undried. It is stated that a 75 per cent. alcohol absorbs better than 90 per cent., and in some cases the globules are directed to be moistened with water before adding the alcoholic solution, to facilitate absorption.

It is largely for the purpose of medicating globules, however, that dilutions are made with alcohol instead of water.

Homeopathic prescriptions are usually abbreviated to an extreme, the nomenclature allowing of this without ambiguity. The strength of preparation usually follows the name, and after this the quantity.

The strength and quantity may also be written in fraction form, the numerator then corresponding to the quantity, and the denominator to the strength, as

℞. Ferri Mur.................3x gtt. vj.
Aquæ Destill..............℥ij. M. Or
℞. Tinct. Ferri Mur...........$\frac{6}{3}$x
Aquæ Destill..............℥ij. M.

Six drops of the third decimal dilution of tincture of muriate of iron are to be diluted with two fluidounces of distilled water.

℞. Aconiti... ....gtt. $\frac{3}{3}$.
Aquæ Dest................℥vj. M. Or
℞. Tinct. Aconiti..............3 gtt. iij.
Aquæ Destillat.............℥vj. M.

Three drops of the third centesimal dilution of tincture of aconite are to be added to six fluidounces of distilled water.

℞. Trit. Natr. Mur .... 30 gr. xij.
Sacchar. Lactis........... q. s.
M. ft. pulv .... xij no. Or

℞. Nat. Mur................ gr. $\frac{12}{30}$.
Sacchar. Lactis........... q. s.
M. ft. pulv .... xij. no.

Twelve grains of the thirtieth centesimal dilution of sodium chlorid are to be mixed with sufficient sugar of milk and divided into twelve powders.

℞. Pil. Nux V .... $\frac{50}{12}$. Or
℞. Nux V................. 12, pil. *L.*

Fifty pills (or globules) of the twelfth centesimal dilution are desired.

℞. Tinct. Bellad .... θ gtt. ij.
Aquæ Destill............ ℥iv. M.

Two drops of mother-tinctures of belladonna are to be added to four fluidounces of distilled water.

℞. (1) Sulph .... $\frac{2}{30}$ Nos. 1–11.
(2) Sulph .... $\frac{2}{200}$ Nos. 2–12.
Mitte tale pulv........... xij. no.

Sig.—A powder night and morning in a wineglassful of water.

This calls for (1) 6 powders of the 30th dilution of sulphur, 2 grains each numbered 1 to 11 (1, 3, 5, 7, 9 and 11) and (2) also 6 powders of the 200th dilution, 2 grains each, numbered 2 to 12 (2, 4, 6, 8, 10, 12). The powders are to be taken in numerical order.

Whatever may be thought of homeopathic remedies and methods, the pharmacist who accepts prescriptions from homeopathic physicians owes it as much to them as to any to prepare such, as far as lies in his power, in accordance with the ideas and wishes of the prescribers.

CHAPTER XVI.

INCOMPATIBILITY.

THE subject of incompatibility is an exceedingly broad and deep one. It means an intimate knowledge of chemical physics and chemical reactions, and since these are constantly being increased, the question of incompatibilities can be said to have no end. As long as pharmacy exists there will be something to learn in this line, and no man can be said to know it all. There is, however, a great difference between *possible* and *probable* incompatibilities, and the study of the latter is not a formidable one, "if there exists primarily a clear knowledge of the chemical and pharmaceutical properties of the substances used." The best and easiest method of acquainting one's self with the general subject of chemical incompatibility is by a study of qualitative analysis, and it is chiefly for this reason that this subject is now taught in colleges of pharmacy. After a course in qualitative analysis, and a systematic study of the official preparations and processes, the student possesses a foundation upon which quite a clear understanding of the usual incompatibilities may be based.

Success at the prescription counter rests very largely upon a correct application of the principles included in these. In no way can the pharmacist be as helpful to the physician as in the correction of incompatibilities, and it were well if every retail pharmacist could have an understanding with the physicians in his vicinity that prescriptions which can be improved without (*positively*) any alteration in medicinal properties, should be so treated by the pharmacist, and full notes of such changes sent immediately to the physician, either by mail or with the medicine to the house of the patient. It should be noted, however, that any study of this sort means not only a study of incompatibilities, but also of the *means of overcoming them.* The physician, like other people, does not like to be told what he *cannot or must not* do; he wishes to know what he *can* do, and if improvements are to be made, he is usually ready to listen.

This phase of the situation is too often neglected by retail pharmacists, to the advantage and profit of the manufacturer, who makes it his chief aim to produce elegant and presentable combinations, which the physicians desire.

Therefore, *study first to know the incompatibilities, and second,* (*more assiduously*) *to know how they may be overcome.* The following notes are arranged with this object in view.

Incompatibilities are of three kinds: therapeutical, pharmaceutical and chemical.

THERAPEUTICAL INCOMPATIBILITIES.

Therapeutical incompatibilities are those in which drugs are combined, which act contrary to each other upon the system. This is purely a question of the medicinal action of drugs, and is beyond the ken of pharmacists. Unless it is obvious that the physician has written absent-mindedly, and ordered combinations which can scarcely be desirable under any circumstances, *or has prescribed dangerous doses*, the question of action should never be raised by the pharmacist in order to correct.

It is well also to remember that antagonistic remedies may be purposely prescribed together, one acting perhaps as a corrective of the other. This is a condition which is found oftentimes in nature, as in rhubarb, which contains both a cathartic and an astringent principle; in digitalis, which contains certain principles which powerfully contract the arteries, and another which dilates them; and in jaborandi, opium and many other drugs, which contain antagonistic principles, but in such proportions that one does not neutralize another, but only modifies or corrects its action.

The pharmacist should never attempt to judge the physician in these matters, but *should ever be on the alert for unusual and dangerous doses or combinations.* It is for the physician to excel in the details of therapeutics, and for the pharmacist to excel in the details of chemistry and physics.

PHARMACEUTICAL INCOMPATIBILITIES.

Pharmaceutical, or physical, incompatibilities are **chiefly cases of insolubility,** as when a body which should be administered in solution is insoluble in the combined ingredients of the mixture, or when a body already dissolved is thrown out of solution by admixture with other bodies. Bodies which are insoluble in the ordinary solvents are not considered incompatible in this sense, unless the nature of the mixture is such that an even diffusion of the insoluble substance cannot be readily obtained.

The larger proportion of pharmaceutical incompatibilities can be remedied by changes in the solvent or by some protective or suspending agent. A clear solution cannot always be obtained, but this may not be necessary when a homogeneous mixture, which can be depended upon to yield an even dose each time of all ingredients, is secured. The treatment of these calls for an intimate knowledge of the solubility of all the common remedies in the ordinary solvents, which can only be learned gradually. It affords an interesting and profitable field for study, which is never-ending, yet not discouraging, and is, moreover, a direct means of success to a pharmacist in many cases.

Among the most common illustrations of physical incompatibilities are:

(*a*) Mixtures of alcoholic tinctures, fluid extracts, etc., with aqueous fluids, the dissolved drug-principles being thrown out of solution.

(*b*) Solutions of metallic salts in aromatic waters, the aromatic oil being thrown out of solution; or solutions of salts in hydro-alcoholic liquids, the alcohol being separated.

(*c*) Supersaturated solutions which should not be filtered.

(*d*) Mucilaginous and albuminous bodies with strong alcoholic liquids.

There are four general methods of remedying or preventing physical incompatibilities:

(1) By the order of mixing.

(2) By changes in the bulk of the mixture, whereby the alcoholic or solution strength is kept within certain limits.

(3) By alterations in the solvents used.

(4) By emulsifying or suspending the troublesome body with gums or syrups.

1. **The order of mixing** has much to do with the final appearance of the mixture. When a prescription is received, the first thought of the dispenser should be, "In what order should these be mixed?" Oftentimes two ingredients, which alone are incompatible, can be made presentable by first mixing one or both with other ingredients of the mixture. It is always easier to *prevent* precipitation or ill appearance than to remedy it, and the order of mixing oftentimes avails in this way. When a mixture calls for a strong alcoholic liquid to be mixed with weaker alcoholic fluids and water, the strongly alcoholic liquid should be gradually diluted with the weaker, and the water added last. By this procedure a less voluminous precipitation occurs.

If a resinous tincture is to be mixed with water, no protective agent being allowable, *the water should be cold and the tincture added to it* in a fine stream, not vice versa. The resinous matters are thus precipitated in a fine condition, and easily diffuse upon shaking. Compound tincture of benzoin, and tincture of myrrh are frequently prescribed in this way. Camphoraceous solutions should also be added to the water, unless other bodies are present which will prevent their separation, when the solution is protected by this before being mixed with water.

2. **Changes in the total bulk of the mixture.**—The alcoholic strength of a mixture frequently determines whether a salt shall remain in solution or not, and contrariwise the presence of a salt in large proportion, which is soluble in water but insoluble in alcohol, may prevent the mixing of alcoholic fluids.

Φ ΔΧ

The alkaloids in certain combinations are the most frequent cases of the first kind. Strychnine in combination with bromides, iodides, and other metallic salts, requires the presence of at least 12 per cent. of alcohol to hold it in solution. In the elixir of iron, quinine and strychnine phosphates of the National Formulary, the alkaloid phosphates are held in solution by the alcohol, and if the elixir is diluted with water, these are precipitated. In such cases it is not the *amount* of alcohol present which holds the salt in solution, but the *proportion or percentage* strength of the mixture; hence the problem is simply to keep the alcoholic strength of the mixture up to that necessary for complete solution. When alcoholic liquids are combined with water, this is best accomplished, not by adding alcohol, but by reducing the quantity of water so that the finished solution measures just half of that originally intended, the dose being changed accordingly.

In the opposite class, when a concentrated solution of a salt throws out of solution a salt which is commonly soluble in water, the simplest remedy is to double the measure of the mixture by addition of water, the dose also being doubled. No. 414 illustrates this. *But such changes in the volumes and doses of prescriptions should never be made without the knowledge and consent of the physician.*

Suggestions for diluting might also be made to the patient whenever it is judged that such will be received intelligently, and without criticism upon the prescriber.

In cases of supersaturated solutions, the insoluble body should be powdered finely, so that agitation will diffuse it evenly throughout the liquid. Never use heat to dissolve the excess of salt, and do not filter.

3. **By alterations in the solvents or by protective agents.**—This requires a pretty thorough knowledge of the comparative value of the different solvents upon the different principles, salts, etc., when in combination. This means something more than the question whether the body is soluble in so many parts of such and such a solvent; it means also the question whether certain *solutions* can be combined without precipitating one of the dissolved bodies.

Water is the great solvent, but aqueous solutions of some salts may not be miscible with alcohol without separation either of the salt or of the alcohol. Much also depends upon the *strength* as well as the *nature* of the solutions, weak solutions often being miscible when strong ones are not.

The chief solvents to be considered in this connection are water, alcohol and glycerin.

Water dissolves gums, albuminous bodies, mucilages, and starch, but these solutions are not miscible with alcohol unless diluted. It dissolves many salts, some of which are precipitated on addition of alcohol, and some are not. Solutions of sugar and other neutral principles in water, are not affected by alcohol, unless in extreme proportions.

Alcohol ranks next to water as a solvent. It dissolves most organic bodies except the carbohydrates (sugars, gums, and starches), such as alkaloids, glucosides, organic acids, neutral principles, volatile oils (only one fixed oil, viz.: castor oil), resins, balsams, camphors ; and most of these are thrown out of solution by diluting with water. Many metallic salts are also soluble in alcohol. Mr. Frank X. Moerk has given the following statements regarding these:

" Metallic salts, soluble in alcohol and water, as a rule, become more soluble as the alcohol is more dilute,—an exception is mercuric chloride.

" Metallic salts soluble in water are not necessarily soluble in alcohol. The converse, however, appears to be true with one important exception, namely: mercuric iodide, which, while soluble in alcohol, is not appreciably soluble in water.

" Metallic salts which *effloresce* are *not soluble* in alcohol. (Exceptions: lead acetate and sodium hydrate.)

" Metallic salts which *deliquesce are soluble* in alcohol. (Exceptions: potassium carbonate and phosphate.)"

" The *metallic salts which are soluble in alcohol* are acetates (excepting mercurous, and silver), benzoates (generally), bromides, chlorates (excepting potassium chlorate), chlorides (excepting those of sodium, potassium, ammonium, silver, lead, and mercurous), iodides (excepting lead, silver, and mercurous), nitrates (excepting potassium, lead, and bismuth subnitrate) salicylates (excepting mercury and bismuth), and valerianates."

" *Metallic salts insoluble in alcohol* are arsenates, arsenites, borates, bromates, carbonates, chromates, citrates, cyanides (excepting mercuric cyanide), ferri-cyanides, ferro-cyanides, fluorides, gallates, hydrates (excepting potassium, sodium and ammonium), hypochlorites, hypophosphites (excepting potassium, sodium and ammonium), hyposulphites (thiosulphates), nitrates, oxalates, oxides, permanganates, phosphates, pyrophosphates, silicates, succinates (excepting those of iron and the alkaline metals), sulphates (excepting ferric and platinic) sulphides (excepting potassium, sodium and ammonium), tannates and tartrates."

It will be noticed from the above list that *most of the acetates, benzoates, nitrates, salicylates, valerianates, and halogen salts* (*i. e.*, chlorides, bromides and iodides, which are mostly deliquescent) *are soluble in alcohol, while nearly all others are insoluble, except those which are also deliquescent.*

Glycerin lies between alcohol and water in solvent properties, dissolving many bodies which are soluble in both. It is an excellent solvent for tannic acid, borax (which it decomposes, developing an acid reaction), carbolic, gallic, and boric acids, creosote, iodine, starch, and many of the metallic salts. It also dissolves normal bismuth nitrate and other similar salts, which are decomposed by water. Glycerin is unobjectionable therapeutically, and is therefore preferred to alcohol in many cases. It is frequently added to prescriptions in the place of a portion of the water, to hold bodies in solution.

Besides these solvents, the use of other salts to dissolve insoluble salts, as given in the table of compound solvents in the chapter on mixtures, is sometimes allowable. This should be practiced very cautiously, as in some cases the medicinal action is altered thereby.

4. **Emulsifying, or suspending the troublesome body with gums or syrup.**—In cases where solution cannot be maintained or secured, it is often advisable to insure an even diffusion of the insoluble body by emulsifying it or incorporating it with a viscid liquid, so that it cannot settle quickly.

When acacia is used, it should be remembered that strong alcoholic liquids cannot be added directly, but a dilute mucilage must be made, to which the alcoholic fluid is gradually added.

Many resinous tinctures, fluid extracts, etc., are suspended in this way.

When tragacanth is used the best results are secured by adding the tincture or fluid extract directly to the powdered gum, and after shaking these together, water is added in the proportion of one of gum to twenty of water, and the mixture should be shaken vigorously until the gum is swollen. Insoluble salts are sometimes suspended by means of tragacanth. Syrup as a suspending agent is used mostly for bodies of light density.

CHEMICAL INCOMPATIBILITIES.

Chemical incompatibility may be known in three ways: By precipitation, or the formation of insoluble compounds; by effervescence, or the evolution of gases; and by changes in color. The formation of a liquid from two solids is not necessarily an indication of chemical incompatibility, but will be included under this head.

Chemical incompatibilities are the most difficult of all to overcome, and in fact cannot be overcome except in very weak cases.

Glycerin and syrup will often retard changes, and in a very few cases prevent it entirely. These are frequently used in cases where changes occur slowly, if at all.

When one of these is present it should be added to one of the suspected ingredients before adding the other. In the absence of these a good rule to follow is to *dilute the reacting ingredients to their full extent before mixing* (*i. e.*, keep them as far apart as possible), *and to mix them cold.*

Precipitation, or the formation of insoluble compounds, forms the largest class of incompatibilities. These take place according to the general rule that *when two salts can by interchange of radicals form an insoluble salt in the liquid present, such insoluble salt will be formed and precipitated.* By the term salt is here meant all combinations of basic (positive) and acid (negative) radicals, acids being considered salts of hydrogen in this sense.

The salts which react may be both soluble, or one or both insoluble, since reactions can take place between dry and insoluble salts.

Insoluble salts are never inert, but they act more slowly upon the system than soluble salts. Thus we know that the antidote for poisoning by corrosive sublimate is white of an egg, an insoluble albuminate of mercury being formed, but if this insoluble albuminate is allowed to remain in the stomach the poisonous action will continue, though more slowly.

Consequently in cases of poisoning by metallic salts an antidote is first given, which, by reaction, will form an insoluble salt, then this is removed from the stomach by an emetic, the emetic being nearly as important as the antidote.

Thus, because of the varying action of medicines in their different forms, incompatible mixtures may be purposely ordered. Whether this is the case in any particular mixture must be decided largely by the dispenser, since upon a proper interpretation of the physician's intentions depends the correct compounding of prescriptions. No positive rule can be laid down for determining this, except that a change in a mixture which results in compounds having a totally different therapeutic action from that of the original ingredients, cannot be considered as designed.

Furthermore, incompatibilities cannot always be foretold, and it may not be until after the prescription has been compounded that they are detected.

Each new prescription thus becomes "a law unto itself," and expertness in compounding is only acquired by combined study and experience.

In the following notes on solubility, etc., reference is made to *pure salts*, but it must be remembered that incompatibility is often due to impurities in the salts used.

Acetates are all soluble. Silver, mercurous and quinine acetates are sparingly soluble. Ferric and aluminum acetates become basic and insoluble, and many others lose acetic acid on exposure to the air, becoming carbonated.

With ferric salts, a deep red color is produced. Quinine is precipitated unless in strongly acid solution.

Acetic acid decomposes carbonates, but is itself displaced by the mineral acids.

Arsenites are insoluble except those of the alkali metals. All are soluble in hydrochloric acid, and some in ammonium chloride or nitrate. The soluble arsenites act slowly as reducing agents. Ferric hydroxide and dialyzed iron precipitate arsenous acid and arsenites very incompletely. Many of the incompatibilities of arsenical solutions are due to acids or alkalis which they contain. Fowler's solution precipitates mercuric chloride and most of the metallic salts.

Benzoates are mostly soluble. They are easily decomposed by mineral acids, the benzoic acid being thrown out of solution. Silver, mercury, lead and quinine benzoates are sparingly soluble. Soluble benzoates precipitate neutral solutions of ferric salts as ferric benzoate, which is flesh-colored.

Borates are insoluble except those of the alkali metals, but the metallic borates are soluble in an excess of boric or tartaric acids, or in borax and tartrates.

Boric acid combines feebly with bases, and is easily displaced by mineral acids, or even by carbonic acid.

Borax, in solution, acts partly as an alkali and partly as a precipitant of insoluble borates. It precipitates lead, barium and calcium as borates, the other metals as basic salts, except aluminum, which it precipitates as hydroxide. It precipitates most alkaloids. It increases the solubility of benzoic and salicylic acids in water.

Borax is decomposed by glycerin, and also by glucose, which liberate free boric acid, thus making it incompatible with carbonates, and compatible with alkaloids and many metallic salts, in the presence of these bodies.

$$(1)\ 2C_3H_5(OH)_3 + Na_2B_4O_7 = 2C_3H_5BO_3 + 2NaBO_2 + 3H_2O.$$

$$(2)\ C_3H_5BO_3 + 3H_2O = C_3H_5(OH)_3 + H_3BO_3.$$

Borax also causes mucilage to become gelatinous. This is overcome by sugar.

Bromides are soluble, except the mercurous, lead, silver, bismuth, and antimony bromides, the latter two being decomposed by water. Non-metallic bromides are also decomposed by water. Mercurous bromide decomposes into mercuric bromide and metallic mercury, making calomel and other mercurous salts dangerously incompatible with bromides.

Oxidizing agents liberate free bromine. Soluble bromides precipitate some of the alkaloids as salts, particularly from strong solutions. This is prevented or reduced by syrup, glycerin or alcohol.

The alkaline bromides frequently contain traces of bromate (which liberates free bromine in contact with acids) and carbonate (which precipitates metallic salts as carbonates) as impurities.

Carbonates are insoluble, except those of the alkali metals. Most of the metallic carbonates are basic salts, and some of these are soluble in an excess of carbonic acid, bicarbonates being formed which are (many of them) soluble. Thus with very cold solutions bicarbonates can sometimes be mixed with certain metallic salts without precipitation, but in most cases an insoluble basic carbonate results, and an effervescence is caused by the escape of carbon dioxide. The carbonates are decomposed by all acids except hydrocyanic.

Chlorides are soluble, except those of lead, mercurous and silver. Hydrochloric acid is decomposed by strong nitric acid, nitrates and other oxidizing agents, liberating free chlorine.

Strong hydrochloric acid changes calomel, in part to corrosive sublimate, but weak acid changes it very slightly, if at all. Concentrated solutions of chlorides may precipitate alkaloidal salts. Hydrochloric acid gives reddish to brown colorations with resinous tinctures. (Ruddiman.)

Chlorates and Hypochlorites are all soluble. They are decomposed by strong acids (the former being fairly permanent if the acid is very weak), liberating free chlorine. They also act as oxidizing agents in acid solutions. Their explosive properties are treated under "explosive mixtures." Sodium chlorate is much more soluble than potassium chlorate. Hypochlorites bleach vegetable colors. With strong hydrochloric acid, chlorates liberate chlorine and chlorine oxides.

Chromates are mostly insoluble in water, but soluble in nitric acid. They are powerful oxidizing agents, and the alkaline chromates decompose many metallic salts, particularly in acid solutions. They must be mixed cautiously with alcohol, glycerin and other organic bodies.

Citrates, except the alkaline citrates, are mostly insoluble or sparingly soluble in water. Citrate of magnesium crystallizes in three different forms, containing 3, 5 and 7 molecules, respectively, of water of crystallization. The first two are quite soluble in water, but the last is only sparingly so, and it is this salt which deposits in solution of magnesium citrate bottles. The alkaline citrates (in neutral or alkaline solutions, but not in those which contain an excess of mineral acids) have the power of dissolving a large number of the insoluble metallic salts, notably those of iron, bismuth and lead. The scaled salts of phosphate and pyrophosphates of iron, and the elixir of phosphate of iron, etc., are instances of such. Soluble citrates prevent the precipitation of most metallic salts by alkalis, unless heated. Soluble bismuth citrate is precipitated by mineral, and by many organic acids. Quinine citrate is sparingly soluble.

Cyanides are insoluble, except those of the alkali metals, alkaline earths and mercuric. All are soluble, however, in an excess of potassium cyanide, or in hydrocyanic and other acids.

Hydrocyanic acid and potassium cyanide are decomposed in aqueous solution into formate and ammonia. Hydrocyanic acid combines feebly with bases, and is displaced even by carbonic acid. Calomel is changed to mercuric chloride and metallic mercury. Oxidizing agents decompose cyanides in strong solutions. When triturated with oxidizing agents in a dry condition, potassium cyanide is liable to explode.

The alkaline cyanides usually have an alkaline reaction, and precipitate the alkaloids from their salt solutions.

Ferricyanides and Ferrocyanides are mostly insoluble, except those of the alkali metals and the alkaline earths. Most of them are soluble either in acids or caustic alkalis.

Ferricyanide of potassium acts as an oxidizing agent in alkaline solutions.

Ferrocyanides are easily decomposed by acids, liberating the poisonous hydrocyanic acid. (The ferri- and ferrocyanides are not, in themselves, poisonous.) With weak acids the decomposition may be very slow. (Moerk.)

Gallates are insoluble in water, with the exception of the alkali gallates. Many of the metallic gallates are soluble in alcohol and in acetic acid and in excess of gallic acid. Alkaloids are *not* precipitated by gallic acid, unless tannic acid is also present.

Gallic acid in aqueous solution turns black on exposure to air and decomposes. This is hastened by alkalis. Excess of alkali with gallic acid produces dark-colored solutions. With lime water, blue, green or pink colorations are produced. With ferric chloride the color is blue-black. Tartar emetic is precipitated by gallates. Also lead acetate. Gallic acid is decomposed by nitrous acid and other oxidizing agents. The solubility of gallic acid in water is increased by alkaline citrates.

Hydroxides are insoluble, except those of the alkalis and alkaline earths, and of lead. They neutralize acids, forming the corresponding salts. The hydroxide of aluminum, zinc, lead, tin, gold and platinum are soluble in excess of sodium or potassium hydroxide.

Alkaloids are precipitated by the fixed alkalies (hydroxides of sodium and potassium) and by ammonium hydroxide, some of them being also soluble in excess. Some alkaloids are decomposed by the fixed alkalis.

By exposure to air, hydroxides absorb carbon dioxide and are changed to carbonates. They decompose ammonia salts, liberating ammonia gas. Sugar, glycerin, and other organic bodies hinder or prevent the precipitation of metallic salts by hydroxides. Some organic bodies, as santonin, cantharidin, chrysarobin, emodin, resins, etc., are rendered soluble, and some, as chloral, glucosides, some alkaloids, salol, ethers, etc., are decomposed by alkalis. Fats and oils are saponified.

Hypochlorites are all soluble, but are very unstable, decomposing even in the cold. They are more permanent in alkaline solutions. Decomposition is hastened by sunlight and by heat. They are powerful oxidizing agents. They bleach vegetable colors.

Hypophosphites are mostly soluble in water, and are decomposed by most acids. They are strong reducing agents, changing under certain conditions to phosphates which are mostly insoluble.

Mercuric chloride and calomel are reduced. Bismuth subnitrate is reduced and darkened. Trituration of hypophosphites with oxidizing agents must be avoided.

Hyposulphites, true, are seldom found. Sodium hyposulphite, so-called, is really sodium thiosulphate. This precipitates sulphur when in contact with acids. It is decomposed by boiling water.

It is also a strong reducing agent, and decolorizes solutions of iodine, forming sodium iodide and sodium tetrathionate. It also dissolves many of the insoluble salts of silver and mercury.

Iodides are all soluble except those of lead, mercury, silver and cuprous. All the iodides are decomposed by strong light, particularly in solution.

The alkaline iodides frequently contain *iodate*, which liberates free iodine in contact with mineral acids. The soluble iodides are also decomposed by nitric and nitrous acids, and by ferric and cupric salts and other oxidizing agents, liberating free iodine.

Soluble iodides are more easily decomposed in acid, than in alkaline or neutral solution. Calomel is changed into mercuric iodide and metallic mercury, by soluble iodides. Ferric chloride liberates iodine. Spirit of nitrous ether liberates iodine.

Fowler's solution forms a precipitate with potassium iodide in strong solution. Alkaloids are precipitated by soluble iodides, particularly in strong solutions.

The alkali iodides are excellent solvents for iodine. Many iodides are soluble in alcohol.

Iodine in alkaline alcoholic liquids forms iodoform, hence tincture of iodine is incompatible with the weakest alkalis. An excess of alkali forms the colorless iodide. It also forms colorless compounds with fixed and volatile oils, tannin, hyposulphites, sulphites, and alkaline carbonates.

Iodine decomposes methyl alcohol in part, forming formic acid and formaldehyd, which are very irritating. With ammonia water an explosive compound may be formed. Oxidizing agents change iodine to iodic acid, and reducing agents form colorless iodides or hydriodic acid.

Iodine acts as an oxidizing agent, and changes mercurous to mercuric salts. Most alkaloids are precipitated by iodine solutions.

Nitrates are all soluble. Bismuth nitrate is soluble in glycerin, but is decomposed by water, forming the basic " subnitrate." Nitric acid is a powerful oxidizing agent, and is reduced sometimes with explosive violence by organic matter. It also decomposes chlorides, bromides, and iodides.

Strong nitric acid should not be mixed with organic matter (alcoholic tinctures, etc., oils, or dry organic compounds) but weak nitric acid may often be combined with organic bodies. With salicylic acid the reddish nitro-salicylic acid is formed. Strong nitric acid gives color reactions with many of the alkaloids. With glycerin the explosive nitro-glycerin is formed. This does not form in the presence of a considerable proportion of water.

Nitrites are soluble, except silver and lead nitrites. As a rule they are less soluble than the nitrates. Neutral nitrites are generally compatible, but in acid mixtures nitrous acid is liberated, which acts sometimes as an oxidizing and sometimes as a reducing agent. Spirit of nitrous ether is troublesome for this reason, decomposing easily and liberating free nitrous acid, which then reacts with liquids containing tannin (liberating nitrous fumes), with iodides (liberating iodine), and with solution of ammonium acetate (liberating carbon-monoxide and other gases). These reactions may be prevented, or at least hindered, by first neutralizing the spirit of nitrous ether with potassium bicarbonate.

Antipyrin gives a green solution, acetanilid a yellow, sodium salicylate a reddish brown, carbolic acid a brown, thymol a brown, guaiac a blue.

Oxalates are mostly insoluble. Tetroxalate of potassium dissolves several of the insoluble salts of iron, tannate, etc.

Oxides are all insoluble. The only oxides from which trouble is to be anticipated in prescriptions are chromic and silver oxides and hydrogen peroxide. All these are oxidizing agents, and should be prescribed alone.

Permanganates are all soluble. They are strong and sensitive oxidizing agents, and should not be mixed with organic bodies, reducing or oxidizing agents. Pills of permanganates are made with kaolin and a fatty excipient.

Phosphates are nearly all insoluble, but are soluble in excess of phosphoric, nitric or hydrochloric acid. Some are also soluble in solutions of organic acids, under favorable circumstances. The insoluble phosphates are also soluble in alkaline citrates, except magnesium phosphates, and these are miscible with metaphosphoric acid.

Ferric chloride is discolorized by phosphoric acid, and the solution is not blackened by tannin. Soluble ferric phosphate is precipitated by phosphoric acid, the precipitate being soluble in excess. Metaphosphoric acid does not cause a precipitate with soluble phosphate or pyrophosphate of iron.

Salicylates.—Salicylic acid and quinine salicylates are the most important of the *in*soluble salicylates met with in pharmacy.

Sodium salicylate is slightly acid in reaction, since if alkaline it is discolored.

Solutions of salicylates turn brown on exposure to air, particularly if alkaline. This is stated to be prevented by the presence of a small proportion of sodium thiosulphate. A strong solution of sodium salicylate dissolves volatile oils, resins, creosote, phenols, menthol, etc. Salicylates give a blue to red color with ferric chloride, a green with copper salts, a brown with bismuth subnitrate and free nitric or nitrous acid. Salicylic acid liberates iodine slowly from potassium iodide, and sodium salicylate slowly combines with free iodine.

Salicylate of sodium forms a damp mixture when triturated with exalgin, urethane, lead acetate or sodium phosphate (Ruddiman). Mineral acids liberate salicylic acid from combination.

Succinates are mostly soluble. The insoluble succinates are dissolved by potassium acetate or citrate solutions.

Sulphates are soluble in water, except those of barium, strontium, calcium, lead, antimony, mercurous and silver. Several of them are soluble in glycerin, but nearly all are insoluble, or but slightly soluble in alcohol. Concentrated sulphuric acid chars most organic bodies. Dilute acid does not.

Sulphides are insoluble, except those of the alkali metals and alkaline earths. All are decomposed easily by acids.

Sulphites are mostly insoluble, except those of the alkali metals, but soluble in acetic and mineral acids. They are oxidized to sulphates by air and oxidizing agents. Acid solutions of sulphites bleach vegetable colors.

Tannates are very unstable, and the basic salts of the heavier metals are insoluble, hence the metallic salts in general yield precipitates when in contact with preparations containing tannin. Gelatin, starch and albumin are also precipitated by tannin. Potassium, ammonium and calcium hydroxides, and potassium carbonate not in excess, precipitate tannic acid from solution. The precipitate is soluble in excess of alkali and becomes dark colored. Very soluble neutral salts may throw tannin out of solution. Aqueous solutions of tannin slowly decompose into gallic and elaigic acids. The solution forms hydriodic acid with iodine. Tannin acts as a reducing agent, and should not be triturated with dry oxidizing agents. In solution, the tannin is decomposed by oxidizing agents. Tannic acid precipitates tartar emetic, some glucosides and alkaloids, the latter being soluble in alcohol. Colored compounds are formed with iron salts and other metallic salts.

Tartrates.—The normal tartrates are mostly insoluble, but the acid tartrates are mostly soluble, potassium and ammonium bitartrates being notable exceptions.

Rochelle salt with mineral acids forms potassium bitartrate, which deposits. Soluble tartrates with potassium salts form potassium bitartrate unless the solution is alkaline. The formation of potassium bitartrate is prevented by boric acid and borax. Tartaric acid is a weak reducing agent, and reduces salts of silver, gold and mercury under favorable conditions. Soluble tartrates prevent precipitation of metallic salts in very many cases. Tartar emetic is precipitated by alcohol and by tannin.

Valerianates are mostly soluble, but are decomposed by many acids, liberating insoluble valerianic acid.

Acids form salts with alkalis and alkaloids, and cause effervescence with carbonates.

The mineral acids displace the weaker organic acids from their salts, and these may be thrown out of solution. They also dissolve oxides.

They precipitate bismuth citrate from solutions of bismuth and ammonium citrate.

It should be borne in mind that acids are contained in the official vinegars (aceta), in extract of colchicum, fluid extracts of conium, ergot, nux vomica and sanguinaria, tincture of sanguinaria, solution of ammonium acetate, syrups of citric acid, hydriodic acid, orange, garlic, calcium lactophosphate, hypophosphites, ipecac, lemon, and squill, in citrate of iron and quinine, solution of acetate of iron, of arsenous acid, of ammonium acetate, of ferric chloride, of ferric nitrate, and infusions of cinchona and rose, paregoric, Basham's mixture, hydrogen peroxide solution, oleates of mercury and veratrine.

Besides these some articles become acid on exposure, as acetic ether, nitrous ether, chlorine water, etc.

Alkalis are incompatible with acids, with metallic salts, alkaloid salts, chloral, and, in strong solution, with organic matter in general. Some organic bodies, as santonin, cantharidin, chrysarobin, emodin, resins, etc., are rendered soluble in water by alkalis, and some, as chloral, glucosides, some alkaloids, salol, ethers, etc., are decomposed. Fats and oils are saponified.

The following preparations contain alkalis: Glycerin suppositories, Fowler's solution, fluid extracts of licorice and senega, syrups of rhubarb and senega, compound iron mixture and pill, seidlitz powders, rhubarb and soda mixture, ammonia liniment, lime liniment.

Aluminum. — The borate, hydrate, oxalate and phosphate are insoluble. Citates, tartrates, glycerin and sugar tend to prevent precipitation. Alum and aluminum sulphate precipitate organic and coloring matters from impure water, and are sometimes used for this purpose when a clear and colorless water is desired in large quantities for washing white precipitates, etc.

Dried alum is very slowly soluble, and may be partially insoluble if overheated in drying.

Ammonium. — The bitartrate is only slowly soluble. All the ammonium salts are decomposed by potassium and sodium hydroxides and carbonates, liberating gaseous ammonia.

Ammonium acetate, bromide and valerianate are very unstable, losing both ammonia and acid. For this reason the former is known to pharmacists only in solution. Ammonium carbonate loses both carbonic acid gas and ammonia, and becomes bicarbonate. Ammonium carbonate and hydroxide form double salts with mercuric chloride, and a black compound with calomel. They are not as active precipitants as the fixed alkali hydroxides and carbonates.

Ammonium hydroxide is official in four forms, as water of ammonia, stronger water of ammonia, spirit of ammonia and aromatic spirit of ammonia. The spirit of ammonia is intended for use in mixtures in which water would cause precipitation, the alcoholic solution being clearly miscible with collodion, tinctures, etc. Care should be used in mixing ammonia water and spirits with preparations containing free iodine, lest the highly explosive compound NHI_2 be formed.

Ammonium chloride tablets containing potassium chlorate have also been known to explode.

Ammonium salts, particularly the acetate, citrate and chloride, have the property of dissolving many of the insoluble salts of the heavy metals.

Antimony.—Only the acetate and tartrate are soluble, but many of the other salts are soluble in strongly acid solutions. Solutions of the tartrate are liable to decompose slowly unless free acid is present. Tartar emetic is precipitated by nitric, hydrochloric and sulphuric acids, by tannin, alcohol and alkalis. Antimony chloride is reduced in aqueous solutions.

Antimony salts precipitate tannin, mucilage and albumin.

The sulphides and oxide are used only in powders, and the former should be mixed cautiously with oxidizing agents.

Tartar emetic (antimony and potassium tartrate) is found in wine of antimony, and in compound syrup of squill.

Arsenic. — Arsenic and its compounds act as acids in most cases. The sulphide is insoluble in acid, but soluble in alkaline solutions. It is not easily compatible with other bodies in fluid form, and is used largely in pills, where, owing to its very slow and slight solubility, reactions do not occur easily. There are four solutions official, all of about the same strength and dose, and intended chiefly to be chosen in regard to compatibility. One is an acid solution, one an alkaline, and two are neutral.

Solution of arsenous acid, "Valangin's Solution," is acid with hydrochloric acid, and is intended for admixture with tincture of chloride of iron and similar preparations. Solution of potassium arsenite, "Fowler's Solution," is alkaline with potassium carbonate, and is intended for use in neutral or alkaline mixtures in the absence of metallic salts. Solution of sodium arsenate is neutral, and also contains the arsenic in an *ic* condition, so that it is better compatible with oxidizing agents. This solution is sometimes improperly called "Pearson's Solution." Solution of arsenic and mercury iodides, "Donovan's Solution," is also neutral. It is precipitated by alkalis, and is itself a precipitant of alkaloids and silver salts, hence it is incompatible with solutions containing alkaloids, unless sufficient alcohol be present to hold these in solution.

Solution of arsenate and bromide of potassium, N. F., "Clemens' Solution," is also almost neutral, and corresponds in strength and compatibility to the official solution of arsenate of sodium.

Barium. — The carbonate, chromate, cyanide, oxalate, peroxide, phosphate, sulphate, and sulphite are insoluble. Barium salts are very poisonous and are never used internally.

Bismuth. — Only the acetate is soluble. The other salts are insoluble or only soluble in highly acidulated water. Bismuth nitrate is slowly soluble in glycerin, but should not be triturated therewith, lest it be decomposed and an explosion follow. Bismuth subnitrate is slowly reduced to oxide by water, liberating nitric acid which reacts with carbonates, iodides, salicylates, etc. Hypophosphites reduce and blacken it.

The subnitrate reacts somewhat readily with other bodies in fluid mixtures; bismuth subnitrate reacts with soluble iodides, forming the red oxyiodide, which reduces in acid solutions to black iodide; with soluble salicylates the red nitro-salicylate of bismuth may be formed; with sodium bicarbonate an interchange of radicals takes place slowly, a very basic bismuth subcarbonate being formed, with sodium nitrate and an evolution of carbonic acid gas, which may burst the bottle. The subcarbonate of bismuth should be used in the last case in place of the subnitrate.

The only solution of bismuth in use is that of the ammonio-citrate, in which bismuth citrate is dissolved in a solution of ammonium citrate. Strong acids decompose the latter salt, and precipitate the bismuth as a normal citrate.

Calcium. — The arsenite, borate, carbonate, citrate, oxalate, phosphate, sulphate, and tartrate are insoluble. Calcium hydroxide and citrate are more soluble in cold than in warm water, and the hydroxide is much more soluble in syrup than in water. On the other hand, calcium hypophosphite is thrown out of solution by an excess of sugar. The carbonate is soluble in water charged with carbonic acid gas, becoming bicarbonate.

Copper. — Only the acetate, arsenite, chlorate, chloride, nitrate, permanganate and sulphate are soluble, the other salts insoluble. Ammonia water dissolves the hydroxide, and this solution dissolves filter paper, cotton, etc. (Much depends upon the condition of the ammonio-copper solution as a solvent for cellulose; it oftentimes fails to act well for this purpose.) Arsenites precipitate green arsenite of copper. Soluble iodides precipitate cuprous iodide, and liberate iodine.

Gold. — Only the bromide and chloride are soluble. Gold salts are reduced with extreme ease by all reducing agents, including ferrous salts, etc., the gold being deposited as a brick-red powder. Alkaloidal salts form insoluble double salts. Potassium iodide precipitates aurous iodide and liberates iodine.

Iron. — Reduced iron usually contains some sulphide which may be troublesome if used for manufacturing small quantities of a salt by dissolving the iron in an acid. Sulphuretted hydrogen is thus formed, a part of which will remain in the liquid.

Ferrous borate, carbonate, cyanide, ferricyanide, hydroxide, oxalate, phosphate, sulphide, tannate, and tartrate are insoluble. The pure ferrous salts are all bright green, but they oxidize readily and darken in color, becoming bluish or reddish-brown. They should be preserved in the light and in well-stoppered bottles. Sunlight will sometimes restore a solution which has partially oxidized. Sugar and glycerin hinder the oxidation. They are all incompatible with oxidizing agents.

The alkaline citrates dissolve the insoluble ferrous salts and also modify their astringent taste.

Ferric arsenite, borate, chromate, carbonate, ferrocyanide, hydroxide, oxalate, phosphate, sulphite and tannate are insoluble. Ferric salts are reddish-brown in color (except the true phosphate), and should be preserved from the light, which reduces them.

Those containing a volatile acid radical, as the acetate, chloride, nitrate, etc., easily lose a portion of the acid and become basic and insoluble. These may be restored by the cautious addition of a little acid, with the aid of a gentle heat, except the acetate, nitrate, and subsulphate, the last of which should be rejected or turned into tersulphate when it refuses to dissolve by aid of heat.

Alkaline citrates and sugar dissolve many of the insoluble salts of iron. This is the case with most of the scale salts, which are combinations of a salt of iron with an alkaline citrate or tartrate.

The iron is not precipitated from these by addition of an alkali, except on heating, but small amounts of mineral acids will sometimes decompose them by destroying the alkaline citrate or tartrate. An excess of the same mineral acid will usually re-dissolve the iron salt.

Iron hydroxide and oxide is dissolved by sugar, under proper conditions (*i. e.*, when the hydroxide or oxide is free from excess of alkali), and this solution does not show the common reactions of iron unless acidulated. Dialyzed iron acts in the same way as the hydroxide, and may be used as a (poor) substitute for the latter in arsenical poisoning.

The inorganic ferric salts liberate iodine from potassium iodide. Ferric acetate does not do this, but will decompose syrup of hydriodic acid, liberating free iodine. This is one reason for the use of syrup and pills of ferrous iodide, the former of which is compatible with the soluble iodides.

Ferric chloride is incompatible with silver and mercurous salts, with alkalis, arsenites and arsenates, borax, albumin, caseine, vegetable extracts and infusions; it gelatinizes mucilage of acacia, and gives colored compounds with many organic bodies, particularly those containing tannin. (See page 310.)

Lead. — The acetate, subacetate, chlorate, nitrate and nitrite are soluble; all other salts insoluble. Solution of subacetate of lead carbonates on exposure to air, or on diluting with water which has stood contact with air and dissolved carbonic acid gas. The subacetate precipitates most vegetable coloring matters, most organic acids, and acacia. In a few cases, glucosides and alkaloids are precipitated also.

Lead sulphate is sometimes desired as an astringent in lotions, and is formed by reaction between a soluble lead salt and a soluble sulphate, in preference to using the dry and less diffusible salt.

Lithium. — Most of the lithium salts are soluble, the carbonate and phosphate being least so. Soluble carbonates and phosphates precipitate lithium carbonate or phosphate from strong solutions. The carbonate is quite soluble in water containing carbonic acid gas.

Magnesium. — The borate, carbonate, hydroxide, oxalate and phosphate are insoluble.

The carbonate is quite soluble in carbonic acid water, and soluble magnesium salts may be mixed, under favorable conditions, with solutions of alkaline bicarbonates (not carbonates) without precipitation.

Magnesium carbonate always contains some hydroxide, which is slightly soluble, and gives an alkaline liquid. For this reason it has been discarded as a distributing agent for the preparation of the aromatic waters, since it renders these incompatible with alkaloidal and metallic salts.

Manganese. — The borate, carbonate, hydroxide, oxalate, oxide, phosphide, sulphite and sulphid are insoluble in water.

Manganese salts resemble iron salts in general properties. Except the hypophosphite and (less frequently) the sulphate, they are rarely used.

Mercury. — All the *mercurous* salts are insoluble in water, except the nitrate, and this is decomposed on diluting largely, a basic salt being formed.

The mercurous salts except the chloride are easily reduced by heavy trituration, contact with metals or reducing agents, and by mixing with certain salts. In all these cases metallic mercury and a mercuric salt are formed.

Sunlight decomposes all mercurous salts, usually turning them dark. Some alkaloids also reduce and blacken calomel and other mercurous salts. Calomel is very sensitive to metals and reducing agents in the presence of moisture.

Hence, mercury salts in general, and mercurous salts in particular, should not be triturated heavily when dry. If necessary to pulverize them (except mercuric chloride) they should be moistened with a little alcohol, water or oil, before rubbing in a mortar.

Contact with certain salts, as bromides, iodides and cyanides reduce them quickly, a more poisonous mercuric salt being formed.

Calomel with chlorides is oxidized slowly to corrosive sublimate, unless the solution is weak. All these changes occur more quickly in liquids than in the dry condition. As a rule it is safe to dispense combinations of calomel with neutral chlorides and with weak hydrochloric acid, unless an oxidizing agent be also present. Slight traces of corrosive sublimate are formed in many instances, but the quantity is too small to produce trouble. Thorough diffusion of calomel through a diluent improves its action. Calomel is, however, more sensitive to change when in this condition, and may oxidize in part to corrosive sublimate on standing.

Contact with liquid alkalis changes calomel to the black mercurous oxide.

Most of the mercurous salts are liable to contain traces of the corresponding mercuric salts as impurities.

Mercuric albuminate, arsenate, arsenite, carbonate, ferrocyanide, iodide, iodate, oxalate, oxide, phosphate, sulphide and tartrate, are insoluble. Alkalis, except ammonia, precipitate the yellow oxide.

Except the chloride, all the soluble salts require the presence of free acid for complete solution, being decomposed by water.

Soluble carbonates and borax precipitate basic salts. Borax forms the brick-red oxychloride.

The mercuric chloride is more soluble in solution of ammonium chloride; mercuric iodide is readily soluble in solution of potassium or sodium iodide.

The double salt formed by mixing solutions of mercuric chloride and potassium iodide, which is known as Mayer's solution, precipitates all alkaloids from acidulated aqueous solutions, except caffeine and theobromine, but these precipitates are soluble in alcohol. Similar compounds are formed with alkaline chlorides and bromides.

In a few cases, concentrated solutions of mercuric chloride precipitate alkaloids, and, rarely, some other proximate principles, precipitation depending upon the strength of the solutions.

Mercuric salts also precipitate albumin, gelatin and tannin, the first (albumin) being given as an antidote to corrosive sublimate poisoning. It is well to know, however, that mercuric albuminate is soluble in excess of albumin and in ammonium chloride solution, and the white of one egg is therefore better as an antidote than the whites of half a dozen. A prompt emetic is necessary in all cases.

Mercuric salts are reduced by most reducing agents, including metals, arsenites, tartar emetic, ferrous salts, alcohol, honey, etc.

Potassium and Sodium.—Only potassium bitartrate is insoluble of the common salts.

Trouble with these is more likely to be found in the impurities than in the salts themselves. Thus the iodides frequently contain small quantities of iodate, which is decomposed by acids, liberating free iodine. The iodate is also poisonous.

When iodides are mixed with spirit of nitrous ether, the latter should be neutralized before mixing, since the presence of mere traces of nitrous acid will liberate the iodine. Such mixtures cannot be kept long without change, unless the nitrous ether is entirely decomposed.

The hypophosphites frequently contain excess of sulphates, which are troublesome when mixed with calcium hypophosphite.

The bicarbonates are readily reduced to carbonates by heat or by hot water.

Silver.— Only the acetate, chlorate, hypophosphite, lactate, nitrate, nitrite and sulphate are soluble.

All the silver salts are reduced by light, by organic matter, and by reducing agents. They should not be allowed to come in contact with metals (steel spatulas) or with vegetable matter. The oxide is quite unstable, and is liable to explode if triturated with organic matter, or with ammonium salts.

Strontium salts are almost identical with the calcium salts in their chemical properties.

Tin salts are little used except as reagents.

Zinc.— The arsenate, borate, carbonate, cyanide, hydrate, oxalate, oxide, phosphate, sulphide and tartrate are insoluble. Zinc salts are used externally as mild astringents, but are seldom used internally. The oxide is liable to be gritty, preventing the formation of a smooth ointment. Only the fine pharmaceutical grade should be used.

ORGANIC BODIES. — **Alkaloids** are vegetable alkalis and usually are the active constituents of the plants from which they are derived. They are mostly powerful medicinal agents, many of them being potent poisons. They combine with acids to form salts, in which form they are mostly used. No other plant-principles do this, and consequently alkaloids may be known by their existence in commerce as sulphate, hydrochlorate, hydrobromate, acetate, etc. In the plants they are combined with organic acids peculiar to the plants, as igasuric acid in nux vumica, meconic acid in opium, kinic acid in cinchona, etc. It is important to remember this, since these organic acids oftentimes form insoluble salts with metallic bases, and salts of the heavier metals are therefore incompatible with many preparations of alkaloidal drugs (tinctures, fluid extracts, etc.). In some cases the alkaloid is carried down with the metallic precipitate, though rarely.

The incompatibilities of alkaloids are numerous, and perhaps, the most important of any class of bodies because of their potency and the liability of an over-dose being taken at the last when the bottle is not shaken each time.

Fortunately, nearly all *the incompatibilities of alkaloids can be overcome by glycerin or syrup, or by alcohol,* a strength of 15 to 40 per cent. of alcohol sufficing in most cases. Thus, the incompatibilities of alkaloidal tinctures, fluid extracts, etc., may, for the most part, be disregarded, unless an excess of water be also present in the mixture.

Sometimes the alkaloidal salts are thrown out of solution as such by other salts. Thus strychnine salts are mostly insoluble in solutions of inorganic salts, but the addition of alcohol to the extent of 12 per cent. of the mixture, holds them in solution.

The principal precipitants of alkaloids are:

Alkalies and Borax. — These decompose the salts of the alkaloids, liberating the latter as free bodies, which are insoluble in water (except caffeine and theobromine, true salts of which are not used in pharmacy). Borax does not precipitate alkaloids in presence of glycerin. The free alkaloids are all, however, soluble in alcohol. Some alkaloids, notably morphine, are soluble in an excess of caustic alkali, but not in the carbonates.

Iodine and Iodides. — The official compound solution of iodine, known as "Lugol's Solution," is a delicate reagent for most alkaloids, precipitating them even in very dilute solutions. The iodides of potassium, sodium or ammonium, alone, are not as delicate, but precipitate from stronger solutions, the precipitates being very bulky in some cases.

Solution of mercuric chloride in excess of potassium iodide, known as solution of iodohydrargyrate of potassium, or "Mayer's Solution," is a very delicate and universal precipitant, precipitating all alkaloids from very dilute solutions, except caffeine and theobromine. It acts best upon acid solutions, and has been used for the quantitative estimation of alkaloids.

It is found in mixtures when mercuric chloride and potassium iodide are combined in them. Mixtures of this sort with alkaloids or alkaloidal tinctures are not infrequent, but the precipitates with this reagent are all soluble in alcohol, hence none is formed in the presence of a sufficient proportion of spirit.

Double iodide of bismuth and cadmium also forms a delicate, though rare precipitant for alkaloids, and the official solution of mercury and arsenic iodides, known as "Donovan's Solution," also acts in the same manner, less delicately.

Bromine and Bromides act in a manner similar to iodine and iodides, but are much less sensitive, as a rule. Strychnine salts are thrown out of solution by potassium bromide, but the presence of 12 per cent. of alcohol redissolves them, as already stated.

Tannic acid, and astringent drugs containing it, also precipitates most alkaloids (in the absence of alcohol), and has been largely used as a reagent for this purpose. In a few cases forms of tannic acid are found in alkaloidal drugs, as cincho-tannic acid in cinchona, in which cases alcohol is required to thoroughly extract the drug, unless a mineral acid be present to replace the tannic acid, as in infusion of cinchona. Combinations of alkaloids with astringents are not unusual.

Other Acids. — Many of the organic acids, as tartaric, gallic, oxalic, etc., and also the inorganic phosphoric acid, form very slightly soluble salts with some alkaloids, and these are liable to precipitation. Alkaloidal salts vary in this respect as do metallic salts, but not as much is known about them. Nearly all the hydrochlorates of the alkaloids are soluble in water, but berberine hydrochlorate is quite insoluble, hence preparations of hydrastis, columbo, and other drugs containing berberine, are liable to form precipitates with this acid. The very slight solubility of quinine acetate and salicylate should be remembered. Some alkaloids have a reducing action, and reduce mercurous and other salts.

Acacia is precipitated hopelessly by solution of subacetate of lead, but not by acetate of lead. Mucilage of acacia forms a gelatinous mass with ferric salts and with borax; the former is liquefied by free acids and by alkaline citrates and the latter by sugar. Alcohol in excess precipitates it in a tough, stringy mass, which is not diffusible. Mucilage of acacia becomes sour and acid on standing, unless prevented by the use of chloroform, beta-naphthol, or other preservative agent.

It has been stated that acacia contains an enzyme which causes decomposition of tannic acid and astringent drug preparations in aqueous solution, decomposes some alkaloids, some phenol derivatives, etc. This enzyme is destroyed by boiling the mucilage of acacia.

Acetanilid is quite stable. It slowly develops a yellow or red-colored solution when dissolved in spirit of nitrous ether. It forms a liquid when triturated with phenol, resorcin and thymol, and a damp powder with chloral. It is slowly decomposed by strong solutions of caustic alkalis.

Acids, Organic.—All the organic acids are displaced from their salts by mineral acids, particularly those which are only slightly soluble in water, as benzoic and salicylic acids, which are easily thrown out of combination and solution by hydrochloric, nitric or sulphuric acids. Excepting acetic acid the metallic salts of organic acids are mostly insoluble, and hence salts of the heavy minerals are generally incompatible with solutions containing organic acids and salts. Many of the organic acids coagulate albumin, a notable exception being gallic acid, which for this reason is more assimilable than tannic acid, and valuable for hemorrhage of the lungs, etc.

Carbolic acid also coagulates collodion, and gives a violet color with iron salts, as does also salicylic acid. Salicylic acid forms a pasty mass when triturated with some of the newer synthetic remedies as exalgin, etc.

Tannic acid, and astringent drugs containing it, precipitates alkaloids, a few glucosides, gelatin, albumin, starch and tartar emetic, and gives an intense black color with iron salts. It also forms precipitates with diluted sulphuric, hydrochloric and arsenous acids, and prevents the blue color of iodine and starch.

Adrenalin is rendered insoluble by alkalis, and is a strong reducing agent, rendering it incompatible with all reducible substances.

Albumin and Albuminates.—Albumin has feeble acid properties, and combines with bases to form feeble salts. Both albumin and the salts are decomposed easily by acids, are precipitated by boiling and by alcohol in excess, and by many of the metallic salts. Tannic, picric, and carbolic acids precipitate albumin and albuminates.

Alcohol.—Alcohol precipitates albumin, gums, and many inorganic salts from aqueous solutions. It is easily oxidized by nitric acid, chromic acid, permanganates, etc. Aldehyde in alcohol is darkened by alkalis. Concentrated mineral acids convert it partly into ethers.

Aloes.—Ferric chloride, strong nitric acid and spirit of nitrous ether give greenish red or yellow colors with tincture of aloes, depending upon the variety and the strength. Alkalis decompose aloin and render it inert.

Alumnol is precipitated by the caustic alkalis, the precipitate being soluble in excess, except when produced by ammonium hydroxide. It is also precipitated by albumin and gelatin, the precipitate being soluble in excess.

Amyl nitrite resembles spirit of nitrous ether (which see) in its properties. It is decomposed by exposure to light and air, becoming acid.

Anthrarobin solutions absorb oxygen, and darken; alcoholic solutions slowly, alkaline solutions quickly. It gives a brownish-green color with ferric chloride and a brown precipitate with lead acetate.

Antipyrin is an artificial alkaloid, and is precipitated under the same conditions and by the same reagents as the alkaloids. It has, in addition, a large number of incompatibilities, which make it immiscible with carbolic acid, syrup of iodide of iron, alum, mercuric chloride, tartar emetic, sodium bicarbonate, ammonia, hydrocyanic acid, arsenic solutions, benzoates, beta-naphthol, etc. It forms a liquid when triturated with beta-naphthol, resorcin, thymol, urethane, pyrogallol, salol, and pyrocatechin.

It forms a green compound with spirit of nitrous ether, when the latter is acid, a red with ferric chloride, and with ferrous iodide, and it slowly blackens calomel. These compounds are not considered seriously objectionable, except that with calomel, wherein corrosive sublimate is formed.

It increases the solubility of quinine sulphate in water and destroys the fluorescence of quinine.

Aristol is decomposed by light and heat, liberating free iodine.

Asoprol is precipitated by solutions of quinine and antipyrin, and is decomposed by carbonates.

Aspirin is decomposed by alkalis.

Atropine. Solutions of atropine salts are decomposed by heat, and the alkaloid is decomposed by alkalis. The alkaloidal reagents precipitate it.

Beta-naphthol liquefies by trituration with antipyrin, camphor, exalgin, menthol, phenol and urethane.

Butyl-chloral is decomposed by alkalis, being converted into allylene dichloride and a formate and chloride of the alkali. It liquefies with camphor, phenol, menthol and thymol.

Caffeine, is not precipitated by alkalis, or the usual alkaloidal reagents, except tannin in strong solutions, and iodine in acid solutions.

Camphor liquefies when triturated or warmed with chloral, butyl-chloral, menthol, thymol, resorcin, beta-naphthol, salol, urethane and carbolic acid. The liquid thus formed is soluble in alcohol and oils, but is thrown out of its alcoholic solution by the addition of water. The presence of camphor in Tully's powder should be remembered in this connection. With resins a soft mass is formed. It unites with iodine and chlorine, and with gaseous hydrochloric, and sulphurous acids.

Fluid mixtures containing camphor with chloral, phenol, etc., may at first be clear; but if much water is also present the liquefied chloral-camphor, camphor-phenol, etc., is liable to separate the oily drops, which require vigorous shaking to diffuse. Any two of these bodies form a liquid of this character when mixed.

Camphor monobromated, liquefies when triturated with chloral, phenol, salol and thymol.

Chloral liquefies, as already remarked, when triturated with camphor, phenol, thymol, menthol, exalgin, methacetin, phenacetin, salol and urethane. A damp powder results with acetanilid. Aqueous solutions of chloral decompose in a short time, becoming acid in reaction. Chloral is decomposed by alkalis, forming chloroform and formate of the alkali. Bottles containing such a combination, which have been stored in a warm place, have exploded from the pressure of chloroform vapor. The incompatibility of chloral with soda or potassa, or their carbonates, with aromatic spirit of ammonia, borax, lime-water, magnesia, etc., is important to remember. In the presence of alcohol and certain very soluble salts, as potassium and sodium bromides, sodium chloride and magnesium sulphate, the chloral may unite with the alcohol to form *chloral alcoholate*, a liquid which exercises a very harsh and irritating action upon the system. This may float upon the surface, or may sink to the bottom according to the density of the aqueous solution. This formation does not occur in the presence of ammonium or calcium bromides, ammonium chloride or potassium nitrate.

Chloral slowly decomposes in solution with potassium iodide, liberating chloroform and iodine.

Aqueous solutions of chloral dissolve resinous bodies and most alkaloids

Chloralamide is also decomposed by alkalis, and by hot water.

Chloralimide is decomposed by mineral acids, forming chloral and an ammonium salt.

Cocaine salts are readily decomposed by alkalis, hot water and by strong mineral acids. It decomposes calomel, and is precipitated by alkaloidal reagents.

Codeine is more soluble, as a free alkaloid, and more strongly alkaline than most alkaloids. It is hence less easily precipitated by alkalis and under favorable conditions it may itself precipitate metallic salts as do alkalis.

Colchicine decomposes easily in aqueous solutions, particularly in the presence of alkalis, or strong acids. It is precipitated by the general alkaloidal reagents.

Collodion. The pyroxylin in collodion is partially reduced by alkalis, yielding a product which is soluble in weakened alcoholic solutions.

Coniine is not precipitated by alkalis.

Creosote is readily oxidized by nitric acid and other oxidizing agents. It is liable to inflame if mixed suddenly with these. Its aqueous solution reduces many salts. It precipitates albumin, and gives colored solutions with ferric chloride.

Creosote carbonate is decomposed by alkalis. In other respects it has the properties of creosote.

Cresol is used mostly in alkaline soap-solutions (as creolin, lysol, etc.), which are hence incompatible with acids, or in acid solution (as sulpho-naphtol, etc.), which are incompatible with acids. These are seldom mixed with other bodies.

Dermatol is decomposed by strong or hot mineral acids.

Digitalin and digitalis preparations are decomposed by strong alkalis and acids, and are precipitated by tannic acid.

Diuretin is decomposed by acids and by carbonates or borax, but not by the caustic alkalis. It reduces silver and mercury salts, and gives colored solutions with ferric chloride. It precipitates some of the salts of the alkaloids.

Ergotin is decomposed by heat, and is precipitated by alkalis, tannin, iodine, and most of the alkaloidal reagents.

Europhen is decomposed by hot liquids and by light. It is incompatible with metallic oxides, and mercury salts, and with starch in the presence of fats,—as in ointments.

Exalgine yields a pasty mass when triturated with salicylic acid, but remains dry with sodium salicylate. It forms a liquid with beta-naphthol, chloral, menthol, phenol, pyrogallol, resorcin, salol, thymol, and urethane.

Formic Aldehyd (Formalin) slowly deposits the crystalline paraform, more rapidly if heated below 100° C. It unites with ammonia, forming an odorless solid, and is decomposed by alkalis, which are neutralized. It forms insoluble compounds with albumin, gelatin, starch, etc., which are not usually stable. It is a powerful reducing agent, and is incompatible with all oxidizing agents. Iodine, hydrogen peroxide, etc., oxidize it to formic acid, which is very irritating. It unites with sulphides and with alkaline sulphites.

Gelatin is rendered insoluble in water by chromic, picric and tannic acids, chlorine water, mercuric chloride, alcohol, alumnol and formaldehyde. Its solution in glycerin, without water, is less affected by these agents. Long heating, and acids or mineral salts, slowly destroy its gelatinizing properties.

Glonoin is decomposed by alkalis, and by water.

Glucosides are decomposed by mineral acids, ferments and by hot water. Alkalis may decompose them. Tannic acid precipitates most of them.

Glycerin is rendered explosive by strong nitric acid, and by other strong oxidizing agents. It decomposes borax, and dissolves some metallic oxides. It prevents precipitation of metallic salts, alkaloids, and other bodies in many cases.

Glycerite of Boroglycerin is decomposed by water.

Glycyrrhizin is precipitated by acids.

Guaiacol and **Guaiacol carbonate** have incompatibilities corresponding to creosote and creosote carbonate.

Heroin is soluble in acids as salts, and is precipitated by alkalis, tannic acid, and other alkaloidal reagents.

Hydrogen Peroxide is decomposed by shaking and rapid heating. It is more stable in the presence of acids, and its solution is slightly acid in reaction. Alkalis decompose it quickly. It is an active oxidizing agent and reacts with all oxidizing and reducing agents, alcohol, glycerin, albumin, etc. It liberates iodine from iodides, and is itself decomposed by admixture with most substances except a few neutral salts. It is usually, and best, prescribed alone.

Ichthyol is precipitated by strong acids and by alcohol. Alkalis liberate ammonia, but do not precipitate it as a rule. Sometimes cloudy solutions are formed. It is precipitated by many metallic salts, and in part by some of the alkaline salts. It precipitates alkaloids from solutions of their salts.

Infusions and Decoctions are immiscible with alcoholic tinctures and preparations containing resinous or oily matter. They are decolorized by solution of subacetate of lead and sometimes by acetate of lead. Precipitates, due to astringent principles, organic acids, etc., are likely to form when corrosive sublimate, tartar emetic, silver salts, iron salts, etc., are added to infusions or decoctions. Those containing alkaloids form insoluble alkaloidal tannates when mixed with astringent preparations, as tinctures of kino and catechu.

Iodoform is decomposed by light and heat and by alkalis. This and many kindred bodies,—*diiodoform*, *aristol*, *iodine trichloride*, *iodophenacetine*, *sozoiodol*, etc., owe their antiseptic properties to the looseness with which they hold iodine, and are more or less easily decomposed by organic matter and salts; hence they should not be mixed with bodies having a strong affinity for iodine, as alkalis, volatile oils, silver salts, etc. Water, fats, tannin and oxidizing agents all decompose iodoform more or less rapidly.

Iodophenin is decomposed by water, liberating iodine. It parts easily with iodine in contact with alkalis, metals, etc.

Menthol liquefies when triturated with beta-naphthol, camphor, chloral, exalgine, phenol, pyrogallol, resin, resorcin, thymol and urethane.

Methacetin liquefies in contact with chloral and phenol, and forms a damp powder with resorcin which dries on standing.

Methylene Blue is incompatible with reducing agents, with strong alkalis, and with potassium iodide.

Morphine is precipitated by alkalis, but is redissolved by solutions of the caustic alkalis and by lime water. It is but slightly soluble in alcohol, and its precipitation is usually not prevented by this body or by glycerin. It reduces oxidizing agents, and is decomposed by them.

Naphthalin liquefies in contact with phenol and salol.

Oils.—Fixed oils are saponified by alkalis, by metallic oxides and solution of lead subacetate, and sometimes by strong acids. With strong nitric acid some of them form a yellow solid body, called *elaidin*. Iodine combines with them in the cold and sulphur when hot. Contact with aqueous fluids causes them to become rancid more rapidly.

With the exception of castor oil (and croton oil, slightly soluble), they are insoluble in alcohol.

Volatile oils are incompatible with nitric acid and strong oxidizing agents. Bromine and iodine react violently with many of them, and form compounds with all. Very soluble salts throw out the volatile oils from their aqueous solutions, as in the aromatic waters. Water and saline solutions also separate them from alcoholic solutions. Many of the volatile oils give color reactions with tincture of ferric chloride.

Osmic acid is a powerful oxidizing agent, changing alcohol into aldehyde and acetic acid, liberating iodine from iodides, etc. It blackens in contact with organic matter. The vapor of osmic acid acts violently upon the eyes.

Pancreatin has its action impaired by acids, while *Pepsin* acts well only in acid solutions. It is precipitated in flocculent condition by alcohol. Heat above 70° C. renders it inert.

Papoid is active in both acid and alkaline solutions. It is injured by heat, and precipitated by agents that precipitate albumen.

Paraldehyde is a strong reducing agent. It unites with alkali hydroxides to form a resinous mass. It is said to liberate iodine from iodides.

Pepsin is precipitated by alcohol, tannic acid, phenol, mercuric chloride and any agent that will precipitate albumin. It is rendered inert by heat and by alkalis. It is thrown out of solution by many soluble neutral salts, as chlorides, sulphates, etc.

Phenacetin is decomposed by strong acids and alkalis. It is liable to contain a poisonous impurity, — paraphenetidin. It forms a liquid when triturated with choral, pyrogallol and phenol.

Phenocoll Salts are decomposed and the base precipitated by alkalis and carbonates of the alkaline earths. It is precipitated by mercuric chloride, ferric chloride, silver nitrate and tincture of iodine.

Phenol (Carbolic acid) forms a liquid when in contact with acetanilid, antipyrin, beta-naphthol, camphor, monobromated camphor, chloral, exalgin, menthol, methacetin, naphthalin, phenacetin, pyrogallol, resin, resorcin, salol, thymol and urethane. It combines with the alkaline hydroxides to form carbolates which are soluble in water. It combines with strong sulphuric acid, forming sulphocarbolic acid. It precipitates gelatin from aqueous solutions. Alcohol neutralizes its caustic and poisonous qualities. It gives a blue color with ferric chloride. Oxidizing agents change it in various ways.

Physostigmin and Pilocarpine have the usual incompatibilities of alkaloids. The latter is not as readily precipitated by alkalis from dilute solutions as are most alkaloids.

Piperazin has an alkaline reaction which causes it to precipitate substances that are thrown out of solution by alkalis. This will not occur if the piperazin be first neutralized with acid. It acts in some measure as an alkaloid, and is precipitated by the more active alkaloidal reagents. It is a reducing agent. It liquefies when triturated with acetanilid, antipyrin, phenol, chloral hydrate or phenacetin.

Protargol is precipitated by alcohol, acids and by some mineral salts, which are acid in reaction. It is not precipitated by sodium or ammonium chloride, or by albumin.

Pyoktannin is decolorized by strong light, in solution, and is precipitated and decomposed by strong alkalis. Excess of neutral salts throw it out of solution.

Pyrocatechin has, in general, the incompatibilities of resorcin.

Pyrogallol is a powerful reducing agent, acting upon solution of mercury and silver salts in the cold. Its aqueous solution absorbs oxygen from the air and darkens, particularly if alkaline. Oxidizing agents and alkalis give various colors with it in aqueous solution. It forms a soft mass or liquid when triturated with antipyrin, camphor, carbolic acid, exalgin, menthol, pyrocatechin, urea or urethane.

Quinine salts are precipitated by acetates (usually not by acetic acid, unless very dilute) benzoates, salicylates and tartrates. Some of the salts are less soluble in strongly-acid than in weakly-acid solutions. The fluorescence of quinine sulphate in weak sulphuric acid solution is destroyed by hydrochloric acid and chlorids, bromides and iodides in dilute solution (strong solutions precipitate the quinine), by hypophosphites, and alkaline citrates in excess, and by acetanilid, antipyrin, phenacetin and piperazin.

Resins. — Alkalis dissolve most resins, forming soaps with them. Strong oxidizing agents decompose them. An alcoholic solution of hydrochloric acid gives a colored solution with many resins which is characteristic. Most resins soften or liquefy when triturated with camphor, menthol, phenol, thymol and salol.

Resorcin darkens on exposure to air, more rapidly in solution and in the presence of alkalis. It gives a bluish color with ferric chloride and with hypochlorites. Nitrous ether gives a red color. It makes a liquid or soft mass with antipyrin, camphor, chloral, phenol, menthol, and some others.

Saccharin. — The aqueous solution is acid in reaction and neutralizes alkalis. It forms agreeable compounds (salts) with alkalis, and dissolves some metallic oxides, as zinc and magnesium oxides. The salts are called saccharinates, but more correctly are sulphaminbenzoates. The best sweetening effects are produced by the sodium salt.

Salicylic acid forms a liquid with exalgin and urethane. Sodium salicylate remains dry with these. (See salicylates.)

Salol is decomposed by strong alkalis and precipitated by bromine water. It forms a fluid when triturated with camphor, monobromated camphor, chloral, naphthalin, phenol, resin, thymol, and urethane.

Salophen gives a violet color with tincture of ferric chloride, Potassium hydroxide aids its solution in water, but is thought to decompose it.

Santonin darkens on exposure to light, and dissolves in alkaline solutions, forming santoninates. It precipitates salts of lead, iron and copper, and is precipitated by tannic acid and by chlorine.

Soaps are decomposed by acids, alkaline earths, and mineral salts. The latter are precipitated as insoluble soaps. They are insoluble in hard waters until after the mineral matters in the water have been precipitated.

Spirit of Nitrous Ether, when neutral and undecomposed, has no important incompatibilities. This is an ideal condition, however, which is rarely ever realized, and never to be trusted. Light and water decompose it, liberating nitrous acid, which causes many troublesome reactions. The decomposition commences as soon as made, and proceeds more or less rapidly according to the exposure and the proportion of water present. With strong alcohol, containing 7 to 9 per cent. of water, the decomposition is very gradual. The spirit becomes acid, then it loses its fragrant odor and becomes unpleasantly pungent, then it darkens.

The acid causes an effervescence with carbonates, neutralizes alkalis, and acts as an oxidizing or a reducing agent according to conditions. It liberates iodine from iodides and bromine from ammonium bromide. Other bromides are not easily decomposed by it (Ruddiman). It oxidizes hypophosphites and sulphites, and reduces chlorates, chromates and permanganates. It produces a green solution with antipyrin and with thymol (green or brown), a yellow with acetanilid and with morphine, a red-brown with salicylates and phenols. Mercurous salts (calomel, etc.) and mercuric salts are reduced.

With tannic and gallic acids, and some other organic bodies, it reacts slowly, giving off gaseous compounds consisting chiefly of nitrogen oxides. This reaction is usually slow and troublesome, and occurs with combinations of nitrous ether with fluid extracts of buchu or uva ursi, tincture of cubeb, and others. When in strong condition it decomposes acetates into carbon monoxide and other gases. Very soluble salts, in fairly concentrated solution, throw nitrous ether out of solution in alcohol, and it volatilizes rapidly, producing the effect of an effervescence.

All these incompatibilities except the last can be prevented by rendering the spirit of nitrous ether permanently neutral with alkali, but the nitrous ether is then decomposed into a nitrite and ethyl alcohol.

Strychnine salts are more easily precipitated than most alkaloids, and they frequently separate only after several hours. Very slight amounts of alkali are sufficient to precipitate strychnine, and bromides and iodides, as well as some chlorids throw strychnine out of solution, sometimes as the original sulphate, sometimes as bromide or iodide. Strong solutions of very soluble neutral salts are liable to precipitate strychnine sulphate from solution. Alcohol tends to prevent the precipitation. Since strychnine is very sensitive to all alkaloidal precipitants, and tends to separate slowly from solution, a shake label is usually advisable on strychnine mixtures.

Sugar solutions form soluble saccharates with lime, magnesia, litharge and other metallic oxides. Hence syrup tends to prevent the precipitation of metallic salts as oxides or hydroxides. Heated with borax it liberates boric acid in a manner similar to glycerin. Many incompatibilities are hindered by syrup, probably by its viscosity and neutral character hindering chemical action. Mineral acids and metallic salts invert cane sugar, slowly in the cold, rapidly when heated.

Heat, with mineral acids, causes a darkening of the sugars. Hence the darkening of syrup of hydriodic acid. Organic acids act similarly but less actively. Strong oxidizing agents decompose sugar, causing explosion if rubbed together in a dry condition, or proceeding quietly in solution.

Milk sugar, in alkaline solution, reduces salts of silver, mercury or copper.

Sulphonal is a very stable body, unaltered by most reagents.

Terebene resinifies and becomes acid on exposure to light. It is readily oxidized by exposure to the air and by oxidizing agents. It combines actively with chlorine, bromine and iodine, forming addition compounds.

Thiol is precipitated from aqueous solutions by acids, strong alkalis, and mineral salts.

Thymol liquefies when mixed with acetanilid, antipyrin, camphor, monobromated camphor, chloral, menthol, phenol, exalgin, resin, salol and methane. It combines with alkalis, and coagulates albumin. It is stated to be three times more soluble in water containing ten per cent. of glycerin than in pure water.

Trional is very stable. It liquefies when rubbed with chloral hydrate or salol.

Urethane is decomposed by caustic alkalis. It liquefies with antipyrin, camphor, chloral, euphorin, exalgin, menthol, naphthol, phenol, pyrocatechin, pyrogallol, resin, resorcin, salicylic acid, benzoic acid, salol and thymol (Ruddiman).

The Formation of a Gas.—This may be known in one of three ways — by an effervescence, by an explosion, or by a combustion. The first two differ only in degree, an effervescence being the bubbling of a gas through a liquid, occurring when free escape of the gas is allowed, and an explosion being the sudden and forcible escape of gas, either from a gradually accumulated pressure within a confined space which at last became powerful enough to burst its container, or from a sudden reaction between two concentrated chemicals whereby a large volume of gas is formed instantaneously.*

Combustion occurs when a gas rich in oxygen is liberated in the presence of an easily combustible body, the latter catching fire.

Effervescent incompatibilities are troublesome only when the effervescence is slow. When it is prompt the general directions given on pages 62 and 63 should be followed, as the incompatibility is intentional in most of such cases.

A very slow effervescence may be due to two causes—(1) the slow escape of gas from a very viscid liquid, or (2) the slow union of chemicals having weak affinities. Instances of the first are found in reactions occurring in the presence of syrups or of glycerin.

Thus syrup of squill is sometimes combined with a carbonate, and the weak acetic acid in the syrup causes the evolution of carbon dioxide from the latter, but owing to the weakness and viscosity of the acid solution the reaction is very slow and persistent. It may be hastened by heating gently, or by making the syrup extemporaneously, *i. e.*, taking an equivalent of vinegar of squill to which the carbonate is first added, and when the reaction (which will be prompt) has ceased, adding the proper amount of sugar and water.

Dobell's solution is sometimes ordered without any water, only glycerin, borax, bicarbonate of sodium and carbolic acid being used, and a strong solution thus made, which is afterward diluted. If these be mixed cold, the reaction does not start promptly, and may continue for several hours. It should be hastened by using a part of the glycerin at first, which is heated with the borax and bicarbonate, and when the reaction has ceased the carbolic acid and the rest of the glycerin are added.

But reactions may be slow owing to purely weak affinities, and in these cases but little can be done. Such are mixtures of bismuth subnitrate and sodium bicarbonate with liquids, the bismuth being gradually reduced and liberating nitric acid, which then reacts with the bicarbonate; also mixtures containing spirit of nitrous ether and tannin, or other bodies which gradually decompose the nitrous ether, liberating oxide of nitrogen. To hasten the reaction in such cases is simply to hasten the decomposition of a desired body, and it therefore should be hindered as much as possible, rather than hastened. To guard against an explosion the stopper should not be pressed tightly into the neck of the bottle, and the customer should be warned of a probable change in the mixture. Such mixtures are usually prescribed in small quantities, that they may be frequently renewed if desired.

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* Explosions may also occur from *physical* causes, as the partial vaporization by heat of very volatile bodies, such as stronger water of ammonia, ether, benzine, etc., confined in tightly-stoppered bottles, or other closed containers. Explosions due to chemical causes only are considered in this chapter.

Explosions and combustions are caused for the most part by violent chemical action, and are more liable to occur during the compounding than afterward.

They are due to a reaction between an oxidizing and a reducing agent.

Oxidizing agents are chemical bodies, rich in oxygen, which under favorable circumstances part with some or all of their oxygen, the latter immediately combining with another (reducing) body.

Reducing agents are those which are capable of combining readily with oxygen, and are therefore bodies which burn easily; or they may be bodies which are raised from a lower to a higher valency by the action of an oxidizing agent. In all reactions occurring between oxidizing and reducing agents, there is a parting with oxygen on the one hand—the oxidizing agent being thereby "reduced"—and a combining with the same oxygen on the other hand—the reducing agent being thereby oxidized. When these reactions occur between dry bodies they are usually accompanied by heat and flame and a detonation; when they occur in liquids, heat and sometimes flame, accompanies them, but usually no detonation.

These reactions occur in liquids spontaneously, but in solids they take place only when heated. It is well known that solids burn only when they are heated to a certain temperature called the "critical point," and so oxidizing and reducing agents may be mixed without any reaction occurring, provided the temperature is kept below the "critical point," and this is true, in a measure, of liquids as well as solids.

Heat is produced by friction, hence if an oxidizing and a reducing agent be *rubbed* together, as in a mortar during the process of mixing, a reaction is liable to ensue, and this reaction may be so violent as to result in an explosion with serious injury to the operator.

Mixtures of this character are, however, frequently called for in pharmacy, and can be dispensed without danger if properly handled. The invariable rule to be followed in the case of solids is to *powder each ingredient separately, then transfer to a sheet of clean paper and mix with a spatula, avoiding pressure.*

The powders may be mixed by sifting if desired, several siftings being necessary, and friction avoided.

Since the explosion is caused, not by the decomposition of a single body, but by a reaction between two bodies, the powdering of each alone may be accomplished safely; but if the same mortar be used for both substances, all traces of the first must be removed before the second is placed in it.

In the case of liquids which are liable to inflame, this may be prevented by *keeping them cold and mixing slowly.*

A partial oxidation is inevitable in these cases, but a rapid combustion may be prevented.

If the reaction becomes too violent it may be checked by cooling with ice water or other suitable means.

Serious injury and even death have resulted to pharmacists in many cases from carelessness in mixing such.

In the following table all the oxidizing agents are incompatible with the reducing agents, the more important and powerful being in heavy type. These should be memorized, and if combined in any mixture, should be mixed with due regard to the precautions already mentioned.

Hydrogen peroxide is peculiar in that it acts both as an oxidizing and as a reducing agent. It reduces oxidizing agents and is itself reduced at the same time, hence is incompatible with all the bodies mentioned in the table. Nitrites may act in the same way, under favorable circumstances.

OXIDIZING AGENTS.

Chlorates.
Hypochlorites.
Chlorine and **Oxides of Chlorine,** including Nitrohydrochloric acid.
Bromine and Iodine.
Bromates and **Iodates.**
Chromates, including chromic acid and bichromates.
Nitrates (nitric acid).
Nitrites (sometimes).
Permanganates.
Peroxides, including hydrogen, sodium and barium peroxides, and lead and manganese dioxides.
Silver Oxide.
Sulphuric acid (with organic matter).
Persulphates.
Ferric, mercuric and cupric salts.
Gold and platinum hydroxides.

REDUCING AGENTS.

Arsenous acid.
Cyanides.
Phosphorus and **Hypophosphites.**
Sulphur.
Sulphides.
Sulphites.
Hyposulphites.
Nitrites (sometimes).
Oxalates.
Pyrogallol.
Ferrous, mercurous and stannous salts.
Powdered **iron** and **zinc.**
Organic bodies, including **alcohol, glycerin, ethers, tannins, sugars, adrenalin, paraldehyd, pyrogallol, alkaloids, vegetable drugs, charcoal,** cork, syrups, extracts, volatile and fixed oils, pyroxylin, creosote, etc.
Hydrochinon.
Hydroxylamin Hydrochlorate.
Formic aldehyde.

Among the most common combinations of these are:

Chlorates of potassium or sodium with tannins and sugar for throat troubles, or with sulphur and sulphides. These are particularly liable to explode with friction, since chlorates part with their oxygen very easily, yielding it up on the application of heat alone.

Chlorates are sometimes prescribed with tincture of chloride of iron and glycerin, for throat troubles. In this case the free hydrochloric acid in the tincture acts upon the chlorate, liberating a highly explosive gas, euchlorine, and unless a considerable water is also present an explosion results should the temperature rise as high as 70° F., a common temperature in summer or heated rooms.

This gas is also formed with other mineral acids.

$$2KClO_3+4HCl=2KCl+Cl_2O_4+Cl_2+2H_2O.$$

The other oxides of chlorine, as nitrosyl chloride, NOCl, which is found in nitro-hydrochloric acid, are also powerful oxidizing agents, and in many cases free chlorine itself. Explosions with these are best prevented by the presence of a considerable proportion of water.

Chlorates are also incompatible in acid solutions with iodides, as potassium iodide, syrup of iodide of iron, etc., the poisonous iodate being formed. With the iron iodide, oxidation to the ferric condition may also occur and free iodine be liberated. Such combinations are inadmissible.

Iodates and bromates act in a manner corresponding to the chlorates, but their use is very rare.

Nitrates, particularly nitric acid, are frequently used as oxidizing agents in the preparation of salts and compounds. Potassium nitrate is one of the principal ingredients of gunpowder, and nitroglycerin is a familiar explosive obtained by the action of nitric acid upon glycerin.

The most common explosive combinations of nitric acid are with oil of turpentine or other volatile oil, creosote, etc. These mixtures should be made in capacious open vessels, the nitric acid being added slowly and the liquids kept cool. Such mixtures, manipulated in this way, are liable to burst into flame, but do not detonate.

In playing the part of an oxidizing agent the nitric acid is split up into water, nitric oxide and oxygen, the latter two bodies acting directly as oxidizers.

$$(2HNO_3=H_2O+2NO+3O.)$$

The nitric oxide becomes further oxidized to nitrogen tetroxide, NO_2 (or N_2O_4), on exposure to the air, a dense brown and irritating fume arising which is obnoxious in the store or laboratory, hence all mixtures in which nitric acid is reduced should be made in the open air or under a hood.

Nitric acid dropped upon the skin forms the yellow xanthoproteic acid, and a similar yellow is produced upon corks or vegetable matter.

Sawdust has been set on fire by spilling strong nitric acid upon it. *Ous* salts are oxidized into *ic* salts by the acid.

Silver nitrate is reduced in solution in aromatic waters (rose water, etc.), by the volatile oil present. Special care must be exercised in making pills of silver nitrate or oxide to avoid reduction by organic matter. Solutions of silver salts should always be dispensed in bottles protected from the action of light.

Nitrites sometimes act as oxidizing agents, sometimes as reducing agents. In themselves they are prone to change to nitrates and are unstable.

Spirit of nitrous ether is perhaps the most troublesome, this being decomposed by light with liberation of nitrous acid, which changes finally to nitric acid.

Nitrous ether is particularly easily decomposed by tannin, acids and alkalis, liberating gases which may burst the container, if tightly closed. The free acids in the spirit cause effervescence with carbonates, and the liberation of free iodine from iodides. These reactions may be hindered by neutralizing the acid before mixing, with a little potassium bicarbonate or tartrate, when no reaction occurs until the ether has become again decomposed by light or other means.

An excess of alkali should never be used, because this immediately decomposes nitrous (and all compound) ethers, forming alcohol and a nitrite of the alkali base.

Chromic acid is a powerful oxidizing agent, causing alcohol, glycerin, and many similar bodies to burst into flame or explode by mere contact. It also acts as a caustic upon the skin, causing painful sores. Bichromates, in the presence of mineral acids, act in the same way as chromic acid. They are used, without the mineral acids, much more frequently than chromic acid.

Permanganates rarely cause explosions. Potassium permanganate acts somewhat slowly but strongly upon such bodies as glycerin, oils, alcohol, and organic matter in general, and is largely used as a deodorizer and purifier. Its disinfectant action is accomplished only when its solution is in contact with the body to be deodorized, the decaying matter being oxidized or burned up by it. Solutions of permanganates should be protected from the light.

Silver oxide is often prescribed in pill form, and explosions have occurred from triturating it with organic matter. Occasionally, pills containing it have exploded several hours after being made. It also forms a very explosive compound with ammonia water and ammonium salts.

Peroxides rarely cause explosions, but like permanganates act slowly and strongly. Peroxide of hydrogen is in itself unstable, and so acts more energetically.

It is seldom used in combination with other bodies.

Iodine sometimes causes explosions when added to volatile oils. It combines with these, and less energetically with fixed oils, forming addition compounds.

It is used in analytical chemistry for determining the purity of oils, each oil combining with a different and known proportion of iodine.

It also forms an extremely powerful and unstable explosive with ammonia water, NHI_2, particularly when iodine is in slight excess. This is not explosive when wet, but explodes violently when thoroughly dried, upon a touch as light as that of a feather. It is liable to be formed in the "decolorizing" of tincture of iodine with ammonia water.

Among the reducing agents, the most powerful and common are:

Phosphorus and the Hypophosphites. — The first ignites spontaneously in the air, and with greater promptness in contact with oxidizing agents. Precautions to be observed in weighing and handling it have already been alluded to. The hypophosphites are unstable bodies, becoming oxidized to phosphites or phosphates.

They have been known to explode from trituration. A very low heat decomposes them, liberating the spontaneously combustible phosphorated hydrogen. They should never be triturated with chlorates or other oxidizing agents.

Sulphur and sulphides combine very readily with oxygen and require special care in mixing and keeping.

Explosions have followed their admixture with chlorates, nitrates and chlorinated lime.

Glycerin is particularly liable to be prescribed with oxidizing agents, and is oxidized by nearly all of them.

COLOR CHANGES. — Changes in the color of galenical preparations are very familiar to the pharmacist. Many tinctures and fluid extracts darken upon standing, particularly when fresh, and a similar change in mixtures is not infrequent. These changes in color are not easy to explain, being, as a rule, imperfectly understood.

From a therapeutic point of view they are commonly unimportant, since no decided change in medicinal properties is observed, but chemically they are interesting, and in a few cases the changes are so marked that the pharmacist should be familiar with them to correctly interpret the appearance of a mixture. Changes in color usually indicate chemical changes in the mixture or liquid, and these may be important, or may not. Thus the iron mixture, No. 17, when fresh, is a handsome ruby color, but it gradually darkens to a very deep brown, and then slowly loses its color, becoming at last nearly white. Its taste also changes, being at first sharply astringent, and at last scarcely at all so, showing the reduction of the ferric chloride to the ferrous condition.

In mixtures the changes are most frequently due to the influence of the body upon another, or to a chemical reaction. In only a few instances are these changes considered objectionable, except that the mixtures are rendered less inviting. Preparations containing tannins are a frequent source of trouble from this cause, and cinchona preparations are frequently deprived of their tannin in order to render them miscible with iron salts without forming an ink.

Color reactions are very frequent in chemical analysis, due to the production of a colored salt which may be soluble or insoluble. A complete list of such reactions or of color changes would be impossible in a work of this nature, and in the list below only those which are frequent or important are referred to. A list of liquids which change markedly is also included.

Acetanilid slowly develops a yellow or red color with spirit of nitrous ether. This reaction is considered unobjectionable, unless the mixture is allowed to stand too long (two weeks or more), when decomposition products result.

Acid, Benzoic, produces a flesh color with ferric salts.

Acid, Carbolic, turns red on exposure to light and air, a coloration which in no way detracts from its value.

Acid, Gallic, darkens in contact with alkalis, becoming green to brown with the hydrates or carbonates, and blue with lime water. It gives a bluish-black color with ferric chloride.

Acid, Hydrocyanic, decomposes in the light and air, becoming brown and finally black. This is partly prevented by a little hydrochloric acid or glycerin.

Acid, Nitric, reduces in the light and becomes yellow or brown, due to presence of lower oxides of nitrogen (hyponitric acid, etc.).

Acid, Oleic, and preparations containing it in a free condition, darken and become rancid.

Acid, Salicylic, produces a violet color with ferric chloride. Salts of salicylic acid darken in the presence of the slightest trace of alkali, and are usually slightly acid to avoid this.

Acid, Tannic, in aqueous solution, darkens and the process is hastened by alkalis.

Alcohol usually contains traces of aldehyde or other impurities which cause it to darken in the presence of alkalis. This is one of the causes of change in spirit and aromatic spirit of ammonia.

Aloin.—Some varieties give a greenish-black color with ferric chloride.

Antipyrin quickly produces a green color with spirit of nitrous ether. This was formerly thought to be a poisonous product, but is now considered safe if the mixture is all used up within two weeks. Long standing results in the formation of other and more objectionable bodies.

Bismuth subnitrate forms a red iodo-compound with iodine, and a red nitroso-salicylate with salicylic acid.

Bromoform turns yellow in the light, showing a decomposition which unfits it for use.

Copper salts give a very deep-blue color with excess of alkalis.

Creosote produces a violet color with ferric chloride, which quickly fades to brown.

Iron salts are productive of a variety of colors. Ferrous salts are green, but turn red or brown on oxidation. Ferric salts are brown or red, but lose their color on reduction. The ferric salts, particularly ferric chloride, produce a violet color with carbolic acid, salicylic acid and salicylates, creosote, salol, oil of cloves, oil of pimenta, oil of bay, and many bodies containing phenol radicals, as anilin, salol, resorcin, guaiacol, cresols, etc.

A red color results with acetates, sulphocyanides, antipyrin and mucilage of acacia.

A flesh-color with benzoic acid and benzoates.

A green with thallin, guaiacol, aloin and preparations of guaiac.

A blue-black with gallic acid, and

A black with tannic acid and preparations containing it, and with gentian.

Tincture of iron chloride forms with phosphoric acid the colorless ferric phosphate, soluble in acids.

Oils of clove, bay and pimenta contain phenol-like principles, which gives a violet color with ferric chloride.

Phenacetin, unless perfectly pure, gives pink to red colors with oxidizing agents, such as chlorine water, solution of chlorinated soda, etc. The color is due to the presence of paraphenetidin or its formation in the liquid.

Pyrogallol in solution darkens rapidly.

Quinine Sulphate exhibits a blue fluorescence when dissolved in a very dilute sulphuric acid. This is characteristic of quinine (and quinidine), and is generally expected in quinine solutions. The fluorescence is destroyed by phenacetin and by hydrochloric acid.

Resorcin turns pink, yellow or deep brown on exposure to light and moisture, more readily in presence of traces of alkaline substances, as ammonia (in the air), alkalis (in glass), etc. With oxidizing agents a series of colorations are produced: thus, ammoniacal silver solution, black; chlorinated soda, violet, finally brown; nitrous acid and spirit of nitrous ether, brown.

Silver salts darken rapidly on exposure to the light. Solutions of silver nitrate, etc., should always be dispensed in amber bottles, or in bottles covered with dark paper, to exclude the light. Blue glass does not prevent this change.

Spirit of Nitrous Ether darkens with tannic acid, and produces a yellow or red color with acetanilid and a bright green with antipyrin, as already mentioned.

Syrup of Garlic turns dark in the light, becoming at last almost black.

Syrup of Hydriodic Acid is reduced by light, as shown by the production of a yellow or brown color. It is then unfit for use if it shows the presence of free iodine. A pale straw-color is sometimes observed in the fresh syrup when there is no free iodine present. The cause of this is a conversion of the sugar under the combined influences of the acid and heat.

If no free iodine can be detected by the starch test (production of a blue color), the syrup may be used.

INCOMPATIBILITIES.

A.—Therapeutical.

404.

℞. Hydrarg. clorid corros . gr. xij
Sacchari . . . . ʒ ss
M. Ft. chart. No. vi. Sig.—One at night.

An over-dose of corrosive sublimate. Calomel was wanted instead.

405.

℞. Acidi arsenosi . . . . ʒ ij
Quininæ sulph . . . . . . ʒ ss
Syr. sarsap. comp . . . . . . ℥ iv
M. Sig.—Teaspoonful three times daily.

An over-dose of arsenous acid. Solution of arsenous acid was wanted instead of the pure acid.

406.

℞. Tincture of nux vomica . . . . Oj
Sig.—Teaspoonful four times daily.

The quantity ordered as well as the dose awaken a suspicion of its use,—for a horse, in which case it is safe.

407.

Poisonous
℞. Liq. plumbi acet. . . . . . . ℥ iv
Sig.—Tablespoonful, as directed.

Solution of ammonium acetate (spirit of Mindererus) was intended.

408.

℞. Morphinæ sulphat. . . . . . ʒ j
Quininæ sulphat. . . . . . . gr. j
M. Ft. pil. xii.

The quantities should be transposed or an over-dose of morphin will be given.

409.

℞. Liq. potassi cit. . . . . ℥ iv
Spt. ætheris nitros . . . . . ℥ j
Syrupi . . . . ℥ j
Tinct. aconiti . . . . ℥ j
M. Sig.—℥ ss. t. i. d.

Contains an overdose of tincture of aconite.

410.

℞. Aconitinæ 03
Sacchari 4.0
M. Ft. pulv. vj. Sig.—One every hour.

An over-dose of aconitine. Probably .003 Gm. was intended instead of .03 Gm

411.

℞.	Ferri sulphat	ʒ j
	Strychninæ sulph.	gr. v
	Acid arsenosi	gr. x
	Quininæ sulph.	ʒ ss

M. Ft. pil. xxx. Sig.—One at night.

The doses of strychnine and arsenic are questionable but not necessarily dangerous, when given only once a day.

412.

℞.	Sodii salicylatis	ʒ ij
	Hydrarg. chlorid mitis	gr. xii

M. Ft. pulv. xij no.

Sig.—One every 3 hours.

The sodium salicylate increases the salivating power of the calomel, and the dose of the latter, considering the frequency of administration, is questionable, though not necessarily dangerous.

B.—Pharmaceutical.

413.

℞.	Potassii citratis	℥ j
	Spt. ætheris nitrosi	ʒ iv
	Syr. tolutani,	
	Aquæ	āā ℥ j

M.

The dense solution of potassium citrate formed in this mixture is immiscible with alcoholic liquids, and the spirit of nitrous ether separates and floats upon the dense fluid.

414.

℞.	Tinct. cardamomi	℥ j
	Spiritus chloroformi	℥ j
	Codeini	gr. iv
	Pepsini	ʒ ss

M. Sig.—Shake. ʒ j. quat. in die.

The pepsin is coagulated by the alcoholic liquids into a rubber-like mass which cannot be diffused through the liquid. Water is needed in such to make an eligible mixture. Two ounces might be added and the dose doubled.

415.

℞.	Quininæ sulph	ʒ j
	Tinct. nucis vomic	ʒ ss
	Spiritus ammoniæ arom	ʒ ij
	Syrupi aurantii	ʒ vj
	Aquæ	ad. ℥ vj

M.

The quinine and oils in the aromatic spirit gradually separate and stick obstinately to the sides of the bottle. The addition of ʒ iv of mucilage of acacia will emulsify these and make a diffusible mixture.

416.

℞.	Hydrarg. bichlor	gr. j
	Potass. iodidi,	
	Ferri et ammon. cit.	āā ʒ iij
	Tinct. cinchon. comp	℥ iss

M. Sig.—Sumat drachmam ter in die.

Water must be used to dissolve the salts.

417.

℞.	Pepsini puri	ʒ j
	Bismuthi subnit	ʒ vj
	Acid hydrochloric	ʒ ij
	Tr. cinchon. comp.	ad. ℥ vj

M.

The pepsin is insoluble in the alcoholic liquid. It should be powdered finely and triturated with the bismuth and acid before adding the tincture.

418.

℞. Potassii bromidi,
Chloralis . . . . aa ʒ iij
Tr. opii camph.,
Syr. zingiberis . . . . . . āā ℥ iss
M.

Chloral alcoholate separates and floats upon the top of the solution. This would not occur in very weakly-alcoholic liquids.

419.

℞. Acidi carbolici . . . . ℥ ss
Aquæ . . . . ℥ iss
M. Sig.—Apply with a brush.

Should not be dispensed as written. The carbolic acid, being incompletely soluble in the water, would settle to the bottom, and the last portions are liable to exercise a caustic action. It might be entirely dissolved by the use of glycerin.

420.

℞. Acidi carbolici,
Sodii boratis . . . . . . āā ʒ j
Cocainæ hydrochlorat . . . gr. xij
Glycerini . . . . ℥ ss
Aquæ menth. pip . . . ad. ℥ vi
M. Sig.—Spray.

The incompatibility between the cocaine and the borax is overcome by the glycerin.

421.

℞. Tinct. guaiaci,
Tinct. myrrhæ,
Tinct. ferri chlor . . . . . aa ℥ j
Mucil. acaciæ . . . . ℥ iij
M.

This cannot be mixed to get a satisfactory preparation, the mucilage being incompatible with all the other ingredients. A green color is also produced on mixing tinctures of iron and guaiac.

422.

℞. Fluidextracti buchu,
Fluidextracti cubebæ . . . . āā ℥ j
Olei terebinthinæ . . . . . . ʒ ij
Tinct. hyoscyami . . . . . . ʒ iv
Mucilag. acaciæ . . . . ut. ft. ℥ iv
M.

These cannot be mixed as written. Emulsify the oil with ʒ ij powdered acacia and ʒ iv of water and dilute the emulsion to ℥ jss. Mix the other ingredients and add to the emulsion very slowly and cautiously.

423.

℞. Strychninæ sulphatis . . . . . gr. j
Potassii bromidi . . . . . . ʒ vii
Aquæ . . . . ad. ℥ viij
M. Ft. solution.

If compounded as written, strychnine bromide is formed and precipitated. If a fluidounce of alcohol be used in place of one of the eight fluidounces of water, the solution is permanent.

(Strychnine bromide is soluble in water, but not in the presence of inorganic salts.)

The two following are permanent solutions because enough alcohol is present in the ingredients to prevent precipitation.

424.

℞. Potassii bromidi . . . . . . ʒ viij
Elixir strychninæ valerianat . ℥ iv
M. Ft. solut.

425.

℞. Strychninæ sulphatis . . . . . gr. j
Tinct. cinchonæ comp. . . . . ℥ iv
Potassii bromidi . . . . ʒ iv
Aquæ . . . . ℥ iv
Syrupi . . . . ℥ j
M. Ft. solut.

426.

℞. Potassii iodidi . . . . ʒ ij
Quininæ sulphat . . . . ʒ ss
Syrupi . . . . ℥ j
Aquæ . . . . ad. ℥ iv
M.

If compounded as written the quinine iodide formed will coagulate into lumps and cannot be well diffused. A better mixture is obtained by dissolving the potassium iodide in two drachms of water, then add sufficient syrup, in which the quinine is just diffused, to make four fluidounces.

427.

℞. Collodii flexilis,
Tinct. iodi,
Aquæ ammon. . . . . āā ʒ ij

Collodion is incompatible with aqueous fluids. Spirit of ammonia should be used in place of the water. (See No. 516.)

428.

℞. Chloroformi,
Chloralis . . . . āā ℥ j
Camphoræ,
Ætheris . . . . āā ℥ ss
Mentholis . . . . ʒ j
Alcohol . . . . ʒ vi
Morphinæ sulphat . . . . . . gr. x
M. Sig. — "Pain paint."

Triturate the chloral, camphor, menthol and morphine together until partially liquefied, then rinse mortar with the mixed liquids and shake together until dissolved. A clear liquid (about 4 fl. oz.) results, which becomes cloudy in about half an hour, and in the course of three or four hours flocculent particles of morphine separate and float upon the surface.

429.

℞. Quininæ sulphatis . . . . . . ʒ ij
Strychninæ sulphatis . . . . gr. ss
Acidi phosphorici diluti,
Tinct. ferri chloridi . . . . āā ℥ ss
Vini pepsini . . . . ad. ℥ iv
M. Ft. solutio.

Dissolve the quinine sulphate in the phosphoric acid and mix with the tincture of iron. (This makes a clear solution, but on diluting it both quinine and iron phosphates are precipitated, and the presence of more free acid is needed, in proportion to the amount of dilution, to keep them in solution.) Add ten drops of hydrochloric acid, and to this mixture slowly add the wine in which the strychnine has been dissolved.

If a precipitate occurs which does not redissolve in ten minutes, a few more drops of hydrochloric acid should be added.

430.

℞. Olei morrhuæ,
Tinct. gentianæ comp.,
Syrupi pruni virgin,
Mucilaginis acaciæ . . . . . āā ʒ j
M. Sig. — A teaspoonful 3 times a day.
Mix in inverse order as written.

(This cannot be made into an emulsion, and none was expected by the physician. It soon separates, in whatever way it may be mixed, and should be dispensed with a shake-label. The only precaution to be observed in compounding is to avoid adding the tincture directly to the mucilage.)

431.

℞. Ichthyoli . . . . ʒ j
Potassii iodidi . . . . ʒ j
Glycerini . . . . ℥ j
Aquæ . . . . ʒ iv
M.

The ichthyol will be partially thrown out of solution by the iodide.

432.

℞. Iodi . . . . ʒ j
Spiritus camphoræ . . . . . . ʒ iv
Aquæ ammoniæ . . . . ʒ iv
Acidi carbolici . . . . ʒ ss
M. Ft. solut.

If the iodine be entirely dissolved in the spirit of camphor and the carbolic acid, and then the ammonia water added very slowly, a clear mixture results.

433.

℞.	Copaibæ	ʒ ij
	Spir. etheris nitros	ʒ iv
	Spir. chloroformi	ʒ j
	Tinct. ferri chlorid	ʒ ij
	Tinct. opii	ʒ j
	Mucil. acaciæ	ʒ iij

M.

The spirits and the tinctures are all incompatible with the mucilage, and with any emulsion which may be formed with the copaiba and the mucilage. On mixing the first five ingredients of the prescription in the order written, then adding the mucilage all at once and shaking vigorously, a stringy semi-solid mass is obtained. If the bottle, loosely stoppered, be placed in hot water for a short time, the spirit of nitrous ether will be quickly decomposed and an acid mixture formed which overcomes the other incompatibilities and yields a thin and smooth chocolate-colored emulsion. This continues to effervesce slowly for some time and the bottle must be loosely stoppered.

434.

℞.	Euphorini	gr. xviij
	Antipyrini	ʒ ss

M. Ft. pulv. vj. no.

On triturating these together a thin paste results (which is solidified by addition of water). By first triturating the euphorin with ʒ j of sugar, then adding the antipyrin and mixing, a dry powder results, which may be dispensed in papers.

435.

℞.	Ext. cascaræ fld.,	
	Ext. hydrastis fld.	āā ℥ ss
	Glycerini	℥ j
	Aquæ menth pip.	℥ ij

M. Sig. — ʒ j post edente.

The glycerin prevents precipitation of fluid extracts.

436.

℞.	Beta-naphthol	ʒ iv
	Sulphuris	ʒ ij
	Balsami Peruviani	℥ j
	Petrolati	℥ j

M. Ft. unguent.

A homogeneous ointment may be made, but it soon separates, owing chiefly to the insolubility of the Peruvian balsam in the petrolatum.

437.

℞.	Potassii bromidi	ʒ jss
	Spiritus æth. nit.	ʒ vj
	Syrupi	ad. ℥ iij

M.

Dissolve the potassium bromide in ʒ ijss of water, mix with ʒ xv of syrup, and then add the nitrous ether. If the nitrous ether is added directly to the bromide solution, before diluting with syrup, a milky mixture results, which clears slowly.

438.

℞.	Fld. ext. gelsem.	ʒ jss
	Fld. ext. cannabis ind.	gtt. xviij
	Antipyrini	ʒ j
	Chloralis	ʒ jss
	Aquæ	℥ j

M.

An oily liquid separates, which subsequently solidifies into a mass of crystals of choral-antipyrin.

With weak solutions this reaction takes place slowly, or not at all.

This prescription should not be dispensed.

439.

℞.	Ext. buchu fld.	ʒ ij
	Tinct. cubebæ	ʒ ij
	Tinct. guaiaci ammon	℥ ss
	Aquæ	℥ ij

M.

The resins in the tinctures and fluid extract are precipitated in an unsightly mass. Acacia or tragacanth should be added to such mixtures to suspend the resins.

(See under emulsions.)

440.

℞.	Zinci oxidi	ʒ ij
	Linim. calcis	℥ ij
M.		

If the zinc oxide be added to the lime liniment, the latter is broken and a lumpy unsatisfactory mixture is obtained. Triturate the zinc oxide with one ounce of lime water, add an ounce of linseed oil and agitate well. A smooth creamy mixture results.

441.

℞.	Tinct. cantharidis	℥ j
	Quininæ sulph	ʒ ij
	Aquæ ammoniæ	℥ ij
	Olei olivæ ut ft.	℥ iv

M. Sig.—apply as directed.

Mixed in the order written, a smooth and creamy mixture results. The quinine dissolves in the excess of ammonia, and the oil is emulsified by the ammonia aided by the alcohol in the tincture.

C. — Chemical.

442.

℞.	Tinct. ferri chloridi	ʒ iss
	Quininæ sulphatis	gr. xv
	Potassi chloratis	ʒ iij
	Sodii hypophosphitis	ʒ iss
	Aquæ	℥ ij
M.		

This is a generally incompatible prescription, the results of which would be a mixture containing ferric chloride, ferric oxychloride, precipitated sulphur, sodium sulphate, sodium chloride, potassium sulphate, potassium chloride, potassium chlorate and quinine chlorate.

443.

℞.	Acid nitromuriat. dilut.	ʒ j
	Spirit. ammoniæ arom	ʒ j

M. Sig. — Two drops in water every four hours.

One ingredient neutralizes the other.

444.

℞.	Argenti nitratis	gr. ij
	Morphinæ sulphat	gr. j

M. Ft. pilulæ xij no. Sig. — One every 3 or 4 hours.

The two ingredients are incompatible. Mix the silver nitrate with 10 grains of kaolin or talc, and mass with hard petrolatum. Work the morphine thoroughly into the mass and divide.

445.

℞.	Argenti nitratis	gr. x
	Cocainæ hydrochlor	gr. xij
	Aquæ	℥ j

M. Ft. lotio.

Silver chloride is precipitated if dispensed as written. This may be prevented and a clear mixture dispensed (in a bottle protected from the light) by using 16 grains of silver nitrate and filtering out the precipitated chloride. The excess of silver is removed in the filtration, and the cocaine will remain in the form of a nitrate.

446.

℞.	Liq. acidi arsen	ʒ j
	Acid nitromur dil	ʒ v
	Pepsinæ in lamellis	ʒ ss
	Elixir bismuthi, N. F.	ad. ℥ vj

M. Sig. — Teaspoonful in water before meals.

The acids will precipitate bismuth from the elixir. The latter is miscible only with neutral or alkaline fluids.

447.

℞.	Sodium salicylatis	ʒ ij
	Sodii phosphatis.	℥ j
	Aquam	ad. ℥viij

M. Ft. solut.

Hard water will cause a precipitate of alkaline phosphates. Only distilled water should be used.

448.

℞. Acid. salicylici . . . . ʒ ij
Ferri pyrophosphat . . . . . . ʒ ss
Sodii phosphatis . . . . ʒ vj
Aquam q. s. . . . . ad. ℥ iv
M. Ft. solut.

Dissolve the sodium phosphate in 3 ounces of water and the salicylic acid in this solution, then add 5 drops of dilute phosphoric acid to prevent precipitation of the iron. Dissolve the iron in half an ounce of water, add to the other, and make up to 4 ounces.

449.

℞. Bismuthi subnit . . . . ʒ ij
Spir. ammon. arom . . . . . ʒ j
Tinct. opii . . . . ʒ ss
Syrupi . . . . ʒ ss
Mist. cretæ . . . . ℥ jss
M.

The bismuth subnitrate is reduced to oxide by the aromatic spirit of ammonia.

450.

℞. Bismuthi et ammon. cit . . . . ʒ ij
Sodii hyposulphitis . . . . . ʒ ij
Tinct. nucis vomic . . . . . . ʒ j
Infus. calumbæ ut ft . . . . . ℥ vi
M.

Black, oxysulphide of bismuth is slowly formed and precipitated.

451.

℞. Potass. bromidi . . . . ʒ iij
Chloralis . . . . ʒ ij
Spt. ammon. arom. . . . . . ℥ ss
Syr. zingiberis . . . . ℥ j
Aquæ . . . . ℥ jss
M.

The chloral is decomposed by the alkaline spirit of ammonia, chloroform being formed. The bottle should be tightly stoppered and kept in a cool place.

452.

℞. Hydrarg. chlorid . . . . . . gr. iij
Tinct. cinchon. comp . . . . ℥ vij
Spir. ammon. arom . . . . . ℥ j
M.

Both ambiguous and incompatible. If the first ingredient means corrosive sublimate, ammoniated mercury will be formed. If calomel, black oxide of mercury will be formed.

453.

℞. Liq. potassii arsenitis . . . . . ʒ j
Hydrargyri bichloridi . . . . . gr. j
Aquæ . . . . ℥ iv
M.

Here is an incompatibility between the alkali in the arsenical solution and the mercury salt.

The acid solution of arsenous acid (Valangin's solution) should be substituted for the Fowler's solution and the mixture colored with a few drops of the compound tincture of lavender.

454.

℞. Liq. hydrarg. et arseni iodidi . m. lxxx
Hydrargyri bichloridi . . . gr. j
Aquæ . . . . ℥ ij

Five grains of potassium iodide should be added to hold the mercury in solution.

455.

℞. Potassii bromidi. . . . . . . gr. x
Hydrargyri chloridi mitis. . . gr. iij
M. Ft. pulv. Mitte tales xij.

On rubbing these together the calomel is reduced to metallic mercury, with formation of a double bromide of mercury and potassium, which is a powerful poison. $2HgCl + 4KBr = (HgBr_2,2KBr) + Hg + 2KCl$.

This should not be dispensed.

456.

℞. Hydrarg. perchloridi.	gr. ss
Ammon. carbonat,	
Potassii iodidi	āā gr. v
Aquæ	℥ j

M.

Alkaline carbonates precipitate mercuric chloride, but in this case if the mercuric chloride and potassium iodide be dissolved first, and the ammonium carbonate added to this solution, no precipitate occurs.

457.

℞. Hydrarg. protoiodidi	ʒ ss
Potassii iodidi	ʒ ij
Tinct. cardam. comp	℥ j
Syr. sarsaparillæ comp	℥ iij

M. Sig. — ʒ j quatuor in die.

The potassium iodide changes the yellow mercurous iodide into red mercuric iodide and free mercury. The red iodide is much more powerful, and in the above would make dangerous doses. This should not be dispensed.

458.

℞. Hydrarg. bichlorid	℈ j
Sodii boratis.	ʒ ij
Aquæ	℥ iv

M.

Oxychloride of mercury, as a brick-red powder, is precipitated.

459.

℞. Hydrarg. bichlorid,	
Ammon. chlorid.	āā gr. iij
Albuminis ovi	ʒ jss
Aquæ destillat.	℥ j

M.

The ammonium chloride prevents the precipitation of mercuric albuminate and the mixture remains clear.

460.

℞. Hydrarg. protochlorid.,	
Iodoformi	āā ʒ ij

M. Ft. pulv. substilis. Sig. — Dusting powder.

These react, on standing, to form mercuric chloride and iodide and chloroform. They should be mixed on paper, without pressure.

461.

℞. Quininæ sulphatis	ʒ ss
Tinct. ferri chlorid.,	
Spt. ammon. arom.	āā ʒ ij
Aquæ font	ʒ xx

M.

The quinine is precipitated and redissolved by aromatic spirit of ammonium, but the latter precipitates ferric hydrate from the tincture and makes a thick, muddy mass. Tincture of citrochloride of iron might be used to get a clear solution.

462.

℞. Ferri et potassii tart.	4
Potassii bromidi	4
Syrupi	15
Aquæ	ad. 60

M.

Dissolve the iron salt in 30 c.c. of water, add the syrup and then add the bromide dissolved in the remainder of the water. If both salts are placed in a bottle and the water added, a dense precipitate results. Mixed as above, the precipitate forms gradually and is less dense.

463.

℞. Tinct. ferri chlorid.	ʒ iij
Liq. ammon. acetat.	℥ iv
Ammon. carbonat.	℥ ss
Elix. curacao	℥ j
Syr. aurantii	℥ jss
Aquæ	q. s. ut ft. ℥ viij

M.

Ammonium carbonate precipitates ferric hydroxide from the tincture.

464.

℞.	Ammon. carbonat.	℈ j
	Spir. æth. nit.	℥ j
	Tinct. ferri. chlor.	ʒ ij
	Spir. mindereri	ad. ℥ iv

M.

The ammonium carbonate is incompatible both with the tincture of iron and the spirit of nitre. Ferric hydroxide is precipitated from the first, and the latter is decomposed. Add the tincture to the mixture last.

465.

℞.	Liq. ferri dialysati	℥ j
	Liq. potass. arsenitis	ʒ ij
	Aquæ	℥ iij

M.

The first two are incompatible, dialyzed iron being used as an antidote (in some cases) to arsenic poisoning.

The alkali in the Fowler's solution also precipitates the iron in a gelatinous mass.

466.

℞.	Ferri et quininæ cit.	ʒ ij
	Acid. phosph. dil.	ʒ ij
	Syr. zingiberis	℥ j
	Tr. cardam. comp.	ʒ iv
	Aquæ	ad. ℥ iv

M. Sig. — Coch. parv. t. i. d.

The phosphoric acid precipitates both the iron and quinine, in part.

An excess of potassium or ammonium citrate would hold the iron in solution.

467.

℞.	Syr ferri iodidi	℥ ss
	Potass. iodidi	ʒ j
	Aquæ	℥ jss

M.

The slight precipitate of iron due to the alkali in the iodide may be corrected by adding five grains of potassium citrate to the iodide solution before mixing with the syrup of iron. Any trace of ferric iodide will liberate iodine.

468.

℞.	Plumbi acetatis	0.25
	Tincturæ opii	2.00
	Aquæ destillatæ	300.00
	Syrupi	25.00

M. Sig. — "Wash."

Dissolve the acetate of lead in all the water and mix the tincture with the syrup, then mix the two solutions. A cloudy mixture results.

469.

℞.	Zinci oxid	ʒ iv
	Acidi salicylici	gr. x
	Amyli	℥ ss
	Adipis lanæ hydros., Petrolati	āā ℥ ss
	Olei lavandulæ	q. s.

M. Ft. unguentum.

Zinc salicylate slowly forms and the ointment becomes lumpy on standing. Triturate the acid with a part of the zinc oxide and a little water, then incorporate the other ingredients, and the ointment will remain smooth.

470.

℞.	Liq. plumbi subacet	℥ ij
	Tincturæ opii	℥ ss

M. Sig. — For external use. Teaspoonful to a cup of cold water.

The solution of subacetate of lead will precipitate most of the principles of the opium and leave a nearly colorless liquid.

471.

℞.	Morphinæ sulphatis	gr. j
	Tinct. lavandul. comp.	ʒ j
	Aquæ	℥ vij

M. Sig. — ʒ j every 4 hours.

Santalate of morphine separates as a red flocculent precipitate (caused by the santalum, an ingredient of the tincture).

472.

℞. Hydrarg. chlorid. corros.	gr. j
Potass. iodidi	ʒ ss
Quininæ bisulphat	ʒ j
Syrupi glycyrrhizæ	℥ j
Aquæ	℥ iij

M.

The alkaloid is precipitated by the double iodide of mercury and potassium.

473.

℞. Hydrarg bichlorid	gr. j
Potassii iodidi	℥ ss
Tr. cinchon. comp.	℥ ij

M.

No precipitation — only a slight cloudiness — occurs in this case, because the iodohydrargyrates of the alkaloids (in the tincture) are held in solution by the alcohol in the tincture. Dispense with a shake label.

474

℞. Morphinæ sulph.	gr. j
Tr. catechu comp.	ʒ ij
Tr. zingiberis	℥ ss
Syrupi ejusdem	ad. ℥ ij

M.

Tannate of morphin is precipitated.

475.

℞. Quininæ sulphatis	ʒ ss
Acid sulphurici dilut	ʒ j
Tinct. cardamomi comp.	ʒ ij
Syr. aurantii	ʒ vj
Aquæ	℥ iij

M.

The tannin in the tinct. cardamom precipitates a portion of the quinine as tannate, and makes a cloudy mixture. *There* would be but little loss of quinine if this were filtered out.

476.

℞. Caffeinæ citratæ	gr. xx
Spt. ammon. arom.	ʒ ij
Elix. guaranæ	ad. ℥ ij

M.

Caffeine forms an exception to the general incompatibility of alkaloids. It is quite soluble in warm water and dilute alcoholic liquids, and does not form salts easily. In the above the citric acid is neutralized by the aromatic spirit, but the mixture remains clear, the caffeine not being precipitated.

477.

℞. Hydrarg. iodid. rubri	0.02
Pilocarpinæ muriatis	0.05
Liq. adrenalini chlor.	0.10
Petrolati albi	5.00

M. Ft. ung.

The mercuric iodide must not be rubbed dry with the pilocarpin, and the adrenalin solution will darken if a steel spatula be used. The three active substances should be incorporated separately with portions of the petrolatum, and then mixed, avoiding the use of a metallic spatula.

478.

℞. Cocainæ	gr, x
Hydrargyri iodidi rubri	gr. ij
Petrolati albi	ʒ iv

M. Ft. ung.

The cocaine muriate should be powdered finely and mixed with a portion of the petrolatum, and the mercuric iodide treated with another portion. Cocaine will reduce the mercury salt if rubbed directly with it.

479.

℞. Ferri et quininæ citratis	℈ ij
Potassii citratis	ʒ ij
Acidi citrici	ʒ j
Aquæ	ad. ℥ vj
M. Ft. solut.	

Acid citrate of quinine separates in crystals after standing a few hours.

The addition of a small quantity of ammonium chloride was recommended to prevent this.

480.

℞. Potassii iodidi,	
Ferri et quin. cit.	āā ʒ ij
Syrupi	℥ j
Aquæ	℥ iij
M.	

Quinine iodide is precipitated in a bulky mass. Can be diffused by shaking, but more syrup will make a better mixture.

481.

℞. Quininæ bisulphatis	ʒ ss
Liq. ferri et ammon. acet.	℥ ij
M.	

The quinine is precipitated and the liquor is partially decolorized.

482.

℞. Quininæ sulphatis	1.0
Acidi nitrici dilut.	1.0
Potass. iodid	2.0
Aquæ	100.0
M.	

Nitric acid liberates iodine from potassium iodide, and the quinine is precipitated. Should not be dispensed, unless for external use.

483.

℞. Tinct. ferri chlorid	ʒ ij
Strychninæ sulph.	gr. j
Hydrarg. chlorid corros.	gr. ij
Acid hydrochloric dil.	ʒ ij
Syrupi acidi citrici ut. ft.	℥ iv
M.	

On standing a double salt of strychnine and mercury is formed and deposited. If aromatic elixir be used in place of syrup of citric acid, the alcohol keeps this in solution.

484.

℞. Piperazin	ʒ j
Strychninæ sulph.	gr. ss
Syr. aurantii	℥ j
Aquæ chloroformi	℥ v
M.	

Piperazin is slightly alkaline and would precipitate some of the strychnine but the acid in the syrup prevents this. Dissolve the piperazin in four ounces of chloroform water and add the syrup. Then dissolve the strychnine in the rest of the water and mix.

485.

℞. Liq. acidi arsenosi	ʒ iv
Strychninæ sulphat	gr. j
Aquæ destillat	ʒ iv
M.	

Strychnine arsenite is formed and precipitated. Alcohol in place of the water will prevent this precipitation.

486.

℞. Iodi	gr. xx
Ext. opii	gr. x
Camphoræ	gr. xv
Ext. belladonnæ	gr. xx
Adipis benz.	℥ j
M. Ft. unguent.	

If potassium iodide be used to dissolve the iodine, the alkaloids in the extracts will be rendered insoluble. Dissolve the iodine and camphor in a little ether, and incorporate with half the lard, warming gently and stirring until the ether has evaporated. Soften the extracts with water, incorporate with the remainder of the lard and mix with the first.

487.

℞. Cocainæ hydrochlor . . . . gr. viij
Sodii boratis . . . . ℈ j
Aquæ . . . . ℥ j
M.

The cocaine (alkaloid) is precipitated by the borax. By triturating the borax with a drachm of glycerin before dissolving this is prevented. Or boric acid may be substituted for the borax.

488.

℞. Sodii salicylatis . . . . ℥ ss
Aquæ menth. virid . . . . . ℈ ij
Acidi sulphurici dilut . . . . . ʒ j
M.

The sodium salicylate is decomposed by the acid, salicylic acid being thrown out of solution.

489.

℞. Sodii salicylat. . . . . ʒ ss
Spt. etheris nitros . . . . . . ℥ ss
Aquæ . . . . ℥ jss
M.

The spirit of nitrous ether must be neutral or it will throw salicylic acid out of solution. If acid in reaction, neutralize with sodium or potassium carbonate before adding to the sodium salicylate solution, being careful not to add too much alkali, as an excess will make a dark-colored solution.

490.

℞. Morphinæ sulphatis . . . . . gr. iv
Acidi tannici . . . . ʒ ss
Acidi carbolici . . . . ʒ ss
Glycerini,
Aquæ . . . . āā ℥ ss
M. Ft. solut.

The glycerin prevents precipitation of morphine tannate in this mixture.

491.

℞. Codeinæ . . . . gr. ij
Acid phosphorici dilut. . . . q. s.
Acid hydrocyanici dilut. . . ♏ xx
Tincturæ iodi . . . . ♏ x
Aquam q. s. . . . . ad. ℥ iv
M. Ft. solut.

The tincture of iodine precipitates the codeine, but on adding the hydrocyanic acid the precipitate dissolves.

492.

℞. Acidi nitrohydrochlor. . . . . ℥ ss
Tinct. cardam. comp . . . . . ℥ jss
M.

This is likely to explode after an hour or two.

493.

℞. Iodi 10
Alcohol 30
Olei terebinth 200
M. Sig. — For inhalation.

Triturate the iodine with the alcohol, and add this mixture to the turpentine in small portions. An explosion will result if the iodine is added directly, or too suddenly, to the turpentine.

494.

℞. Acidi chromici,
Glycerini,
Alcoholis . . . . . āā p. e. ad. ℥ ss
M. Sig. — Apply as directed.

Very inflammable and explosive. Should not be dispensed.

495.

℞. Bismuthi subnit . . . . ʒ ij
Sodii bicarb . . . . ʒ j
Aq. menth. virid . . . . ℥ ij
M.

The bismuth and sodium salts react slowly, forming bismuth oxide and sodium nitrate, with evolution of carbonic acid gas. The bottle should be loosely stoppered.

496.

℞. Bismuthi subnit . . . . ʒ ss
Mist. cretæ . . . . ℥ jss
Tr. opii . . . . ʒ iv
M.

The bismuth subnitrate will be slowly decomposed by the chalk in the chalk mixture, carbonic acid gas being evolved.

497.

℞. Potassii chloratis . . . . ʒ iij
Tinct. ferri chlorid . . . . . . ʒ ij
Glycerini . . . . ℥ ij
M. Sig. — Apply with a camel's hair brush.

Must be kept cold (below 70° F.) to prevent explosion. Stopper loosely as an additional precaution and caution against a possible combustion.

498.

℞. Tinct. aconiti . . . . m. xvj
Spt. ætheris nitros . . . . . ℥ ss
Liq. ammon. acet . . . . . . ℥ jss
M.

The ammonium acetate throws the nitrous ether out of solution, and an effervescence ensues. If the ingredients are warm, the effervescence is very active.

499.

℞. Spir. ætheris nitros . . . . . . ʒ vj
Ext. buchu fluidi,
Ext. uvæ ursi fld. . . . . āā ʒ iv
Syrupi q. s. ut. ft. . . . . . . ℥ iv
M.

A slow reaction between the tannin in the fluid extracts and the spirit of nitre will occur, and the bottle may burst if tightly stoppered. Shake well before delivering, and instruct the customer to keep loosely stoppered.

500.

℞. Acid salicylici . . . . ʒ v
Lithii carbonatis . . . . gr. x
Sodii bicarbonatis . . . . . . ʒ iij
Olei gaultheriæ . . . . ʒ iij
Glycerini . . . . ℥ iv
M.

Heat the glycerin to about 150° C. dissolve the salicylic acid in it by trituration, and add the lithium and sodium salts gradually, stirring to favor the disengagement of gas. Then cool, add the oil and dispense with a shake label. Unless the reaction is hastened by heat, the effervescence will be extremely slow.

501.

℞. Potassii bitart . . . . ℥ j
Potassii iodidi . . . . ʒ j
Spir. æth. nitros . . . . ʒ iv
Syr. aurantii. . . . . ℥ j
Aquæ . . . . ad. ʒ x
M.

This cannot be compounded without reaction between the first three ingredients resulting in the entire decomposition of the spirit of nitrous ether, and partial decomposition of the other two. The "Art of Dispensing" directs to proceed as follows: "If compounded at all, dissolve ʒ j of cream of tartar and 8 grains of potassium iodid in 4 oz. of water, add the spirit of nitrous ether, and stir briskly so that the gas may escape. Allow to stand half an hour, in order to get rid of the nitrous fumes. Then make up the rest of the mixture and add to this. The object of this procedure is to limit the action of the nitrous ether, for while theoretically the 4 drachms will liberate the iodine from about 8 grains only of the iodide, the liberated nitrous oxide on coming in contact with the air is changed to higher oxides, which are capable of decomposing iodide, so that if the mixture were made up at once, iodide would continue to be liberated until the whole of the potassium iodide is decomposed."

502.

℞. Ammonii carbonat . . . . . . ʒ ij
Syrupi simplic.,
Mucil. acaciæ . . . . . āā ℥ iss
Aquæ . . . . ℥ ij
M.

If the mucilage is old an effervescence may ensue, caused by the acid in the mucilage reacting upon the carbonate.

503.

℞.	Syr. scillæ	℥ j
	Syr. senegæ	℥ ss
	Potass. bicarb	℈ ij
	Tinct. opii	ʒ ij
	Syrupi	ad. ℥ iv
M.		

The syrup of squill contains acetic acid, which neutralizes the ammonia in the syrup of senega, and causes an effervescence with carbonates. The bicarbonate should be added first, and when the effervescence has ceased, the other ingredients are added.

504.

℞.	Ammonii carbonat	ʒ j
	Ammonii chloridi	ʒ ss
	Syrupi scillæ	℥ j
	Syrupi ipecacuan	℥ j
	Syrupi pruni virgin	℥ ij
M.	Sig.—ʒ j for cough.	

The acids in the syrups of squill and ipecac react slowly with the ammonium carbonate, liberating carbonic acid gas.

505

℞.	Codeinæ	gr. iv
	Ammon. chlorid	ʒ iij
	Ext. hyoscyam. fld.,	
	Tr. nucis vomic.,	
	Sp. chloroformi,	
	Elix. cascar. sagrad.	aa ʒ iv
	Aquæ	q. s. ut. ft. ℥ vj
M.		

The alkali in the elixir of cascara reacts with the ammonium chloride, liberating ammonia gas. Sufficient pressure may be generated, in a warm place, to blow out the stopper of the bottle.

506.

℞.	Tinct. iodi	℥ j
	Linim. camph. comp	℥ iij
M.		

Compound camphor liniment (Ph. B.) contains ammonia water, and is liable to form the explosive nitrogen-iodine compound (NHI_2) with the tincture of iodide. This compound is an extremely powerful explosive, and very unstable when dry.

507

℞.	Iodol	0.5
	Hydrarg. oxid. flav.	0.2
	Petrolati	10.0
M.	Ft. ung.	

If the iodol and oxide of mercury be rubbed together, an explosion will take place. This does not occur in presence of the petrolatum or a portion of it.

508.

℞.	Argenti nitratis	ʒ j
	Aquæ rosæ	℥ j
M.	Ft. lotio.	

The silver nitrate is rapidly decomposed by the rose water, the liquid turning black and depositing a heavy sediment. Distilled water should be used and the solution dispensed in an amber or covered bottle, to prevent reduction of the silver salt by light.

509.

℞.	Oleatis morphinæ	℥ ss
M.	Sig. — Apply as directed.	

If fresh and light-colored when dispensed, this rapidly darkens.

The same change in color occurs with mercury oleate.

510.

℞. Potassii permanganatis . . . . ʒ j
Glycerini . . . . ℥ j
Aquæ . . . . ℥ ij
M.

The glycerin decomposes the permanganate, entirely discharging the color of the solution and forming a dense brownish precipitate.

If the permanganate is added directly to the glycerin, the latter is liable to inflame.

511.

℞. Bismuthi subnit. . . . . ʒ ij
Sodii salicylat. . . . . ʒ ij
Aquæ cinnamomi . . . . ℥ ij
M.

The insoluble bismuth salt gradually turns red, owing to the formation of bismuth nitro-salicylate.

512.

℞. Bismuthi subnit. . . . . . . ʒ ij
Pulv. tragacanth . . . . . . q. s.
Tinct. nucis vomicæ . . . . . ʒ ij
Potassii iodidi . . . . ʒ ij
Spiritus chloroformi . . . . . ʒ iij
Aquæ . . . . . . q. s. ut. ft. ℥ xij
M.

Red iodide of bismuth is formed in this mixture. The bismuth should be given separately as a powder.

513.

℞. Tinct. ferri chlorid. . . . . . ʒ ij
Tinct. gentianæ comp. . . ad. ℥ iv
M. Sig. — Teaspoonful after meals.

Makes an inky mixture.

514.

℞. Tinct. ferri chlorid. . . . . . . ʒ j
Quininæ sulph . . . . ʒ j
Tinct. cinchon. comp. . . . . . ℥ ij
M. Sig. — ʒ j in aq. t. i. d.

The quinine is soluble in the tinctures, but the mixture is inky.

515.

℞. Tinct. ferri chloridi . . . . . ʒ ij
Syr. aurantii corticis. . . . . . ℥ j
Aquæ . . . . q. s. ad. ℥ iv
M.

The tannin extracted from the orange peel may make a dark mixture with the tincture of iron.

516.

℞. Tinct. iodi,
Aquæ ammoniæ,
Collodii. . . . . āā ℥ j
M.

Pyroxylin in first precipitated by the water of ammonia, but after about 24 hours is partially reduced by the excess of ammonia and redissolved. The mixture is nearly colorless at first, but turns reddish-brown on standing. With spirit of ammonia the mixture remains clear from the first, but undergoes similar color-changes. Various ammonia compounds are formed.

517.

℞. Acidi carbolici . . . . ʒ ss
Tr. ferri chlorid . . . . ʒ j
Glycerini . . . . ℥ j
M. Sig. — Apply with brush every 3 hours.

Makes a deep violet-colored mixture.

518.

℞. Saloli . . . . ʒ ij
Tinct. ferri chlorid . . . . . . ʒ ij
Spiritus æth. nit . . . . ℥ j
Glycerini . . . . ℥ ss
Aquæ . . . . ℥ v
M.

Suspend the salol in the glycerin, add the water and then the tincture and spirit. A lighter-colored and less changeable mixture is obtained in this way than if the salol be dissolved in the tincture and spirit.

519.

℞. Tinct. ferri chlorid. . . . . . ℥ ss
Acidi carbolici . . . . ʒ j
Acidi sulphuros. . . . . ʒ iij
Aquæ. . . . . ad. ℥ viij
M. Ft. garg.

Very dark blue at first, but the color becomes discharged after a short time.

520.

℞. Tinct. ferri chloridi 2
Acidi phosphorici dil 2
Syrupi 60
M.

The first two are incompatible, insoluble phosphate of iron being formed which is soluble in an excess of phosphoric or hydrochloric acid, making a colorless solution.

521.

℞. Liq. potassii arsenitis . . . . ʒ ijss
Tinct. ferri chloridi,
Acidi phosphorici dilut. . . āā ℥ j
Aquæ. . . . . ad. ℥ vj
M.

The first and second and third are incompatible, but a clear, colorless solution is obtained by first mixing the Fowler's solution and phosphoric acid, then adding the tincture of iron and lastly the water. "*Shake.*"

522.

℞. Tinct. ferri chloridi . . . . ʒ ij
Quininæ sulphat . . . . . gr. xviij
Spt. chloroformi . . . . . ʒ j
Aquæ caryophylli. . . ad. ʒ vi
M.

A very dark mixture results, and a precipitate may form on standing, owing to a reaction between the iron and eugenol in the cloves.

523.

℞. Antipyrini . . . . ʒ j
Sp. ætheris dulc. . . . . . . ʒ ijss
Syr. limonis . . . . ℥ ss
Aquæ . . . . ad. ℥ ij
M.

A green color is developed on mixing the antipyrin with the spirit of nitrous ether, due to the formation of isonitroso-antipyrin. It may be dispensed.

524.

℞. Potassii iodidi . . . . ʒ jss
Spiritus ætheris comp,
Syrupus,
Aquæ. . . . . āā ʒ j
M.

The official compound spirit of ether usually contains some free sulphuric acid, which may liberate iodine from the potassium iodide and color the mixture.

525.

℞. Tr. ferri chlor. . . . . ʒ j
Acidi nitromur. dil. . . . . . ʒ jss
Quininæ muriat . . . . gr. x
Potassii iodidi . . . . ʒ ss
Ext. digitalis fld . . . . ♏ x
Syrupi simplic . . . . . . ad. ℥ ij
M.

Iodine is liberated from the potassium iodide by the iron and acid, and this, with the undecomposed iodide, precipitates the quinine, making a very unsightly and unpleasant mixture. The iodide should not be included in such a mixture.

526.

℞. Liq. iodi comp.,
Liq. potassæ . . . . āā ℥ j
M.

The iodine will be partly converted into colorless iodide and iodate of potassium.

527.

℞. Potassii chloratis . . . . . . ℈ ij
Syr. ferri iodid . . . . ʒ iv
Spiritus chloroformi . . . . . ♏ xx
Syrupi . . . . ʒ iv
Aquæ . . . . ad. ℥ ij
M.

If the syrup of iodide of iron contains any free acid (citric or hypophosphorous acids put in to preserve it), or if it has oxidized, a reaction is likely to ensue, liberating chlorine from the chlorate, which in turn liberates iodine from the iodide, and the mixture becomes brown, then deposits iodine. This reaction can only be prevented by keeping the solution neutral by addition of a little calcium carbonate or similar neutralizing body.

528.

℞. Acidi tannici 1.0
Tinct. iodi 0.5
Glycerini 10.0
Aquæ 50.0
M. Ft. lotio.

The tincture of iodine will be decolorized by the tannin.

529.

℞. Sodii salicylat. . . . . gr. x
Ammon. carbonat. . . . . . gr. iij
Spt. ætheris nit. . . . . . . ♏ xx
Spt. chloroformi . . . . . . ♏ x
Aquæ . . . . ad. ℥ j
M.

Becomes red in a few hours.

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